May / 1961

- *Automating the candy plant*
- *Studies on fat bloom formation*
- *Effects of physical properties on taste of confections*
- *Radiant cooling of chocolate products*

MC

the Manufacturing Confectioner

specialized publication for confectionery manufacturers

How Belting insurance protects Mrs. Snyder's

DIVISION FANNY MAY — KITCHEN FRESH CANDIES

Miragloss Tunnel Belt imparts desired gloss to bottoms as candy emerges from enrober at Mrs. Snyder's big Chicago plant.

You spend thousands of insurance dollars annually to protect your property. Doesn't it make just as good sense to protect your candy during production?

Here's what "premium-free" Burrell Belting Insurance means to you:

- **The best belt for each specific job**
- **Prompt delivery**
- **Burrell's 48 year record of regular follow-up service**

Check with any Burrell "insured" plant. You'll find that this complete Protection Service will free you, too, from all belting problems.

Double Texture Reflecto Belt has a crackless glazed surface, carries centers over cold table.

Double Texture Reflecto Belt (left) and Endless Treated White Cotton Single Ply Belt (right) provide quick transfer and release of centers at bottomer station.

Miragloss Glazed Belt of flexible design channels finished candies moving over Vibra-Pak equipment to packing station.

Write for the new Catalog describing the full Burrell Belting line for candymakers.

BURRELL BELTING COMPANY

7505 N. ST. LOUIS AVE., SKOKIE, ILLINOIS

Chicago Phone: AMbassador 2-8110

BRANCH OFFICES:

New York Area:	DUmont 5-7152, 36 Shelby Street, Dumont, New Jersey.
Chattanooga Area:	TRemont 7-6156, 1420 August Drive, Hixson, Tennessee.
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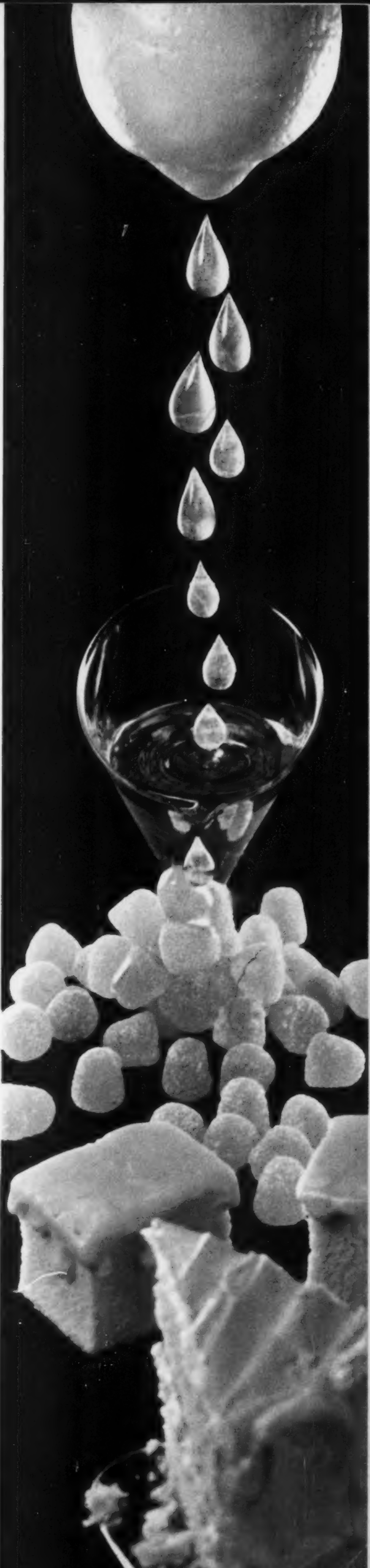
Milwaukee Area:	Liberty 2-4949, 1120 Evergreen Drive, Waukesha, Wisconsin.
San Francisco Area:	YOrkshire 7-5993 or ENterprise 1-1061, 1062 East Rose Circle, Los Altos, California.



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Bloom inhibiting agent developed, patented

The development of an agent for the inhibition of chocolate fat bloom was announced at the annual Production Conference of the PMCA last month. Patent number 2,979,407 was issued just two weeks before the conference to cover this development. In making the announcement, Jay C. Musser, chairman of the research committee of the PMCA, said that the procedures for use under this patent had not as yet been made, but that arrangements would in all probability be completed for licensing by the middle of the year.

The research work that led to the discovery of this bloom inhibiting agent was done by the PMCA director of research, William N. Duck at the PMCA candy research laboratory at Franklin and Marshall College in Lancaster, Pennsylvania. A portion of the patent follows:

"A bloom inhibited chocolate product comprising a major portion of edible chocolate and a minor portion of from 0.5% to 5% by weight of a stabilizing material, said stabilizing material comprising a mixture of triglyceride esters based on the ratio of 2 moles of lauric acid, 1.2 moles of myristic acid and 2 moles of palmitic acid, the stabilizing material having a melting point in the range from 104°F to 118°F".

Wolflisberg heads international food congress

Hans J. Wolflisberg, president of The Nestle Company, Inc., is general chairman of the 5th International Food Congress, scheduled for the New York Coliseum, September 8-16, 1962.

The '62 meet is expected to draw upwards of 50,000 food industry members from 30 nations. Dramatic exhibits, showing the great strides the food industry has made in making the U. S. the best-fed nation in the world, will be open to the public during this international food industry conclave. (A good place, it would seem, for candy to be in prominence.)

Previous four congresses were held in Paris, 1950; Ostende, Belgium, 1953; Rome, 1956; and Lausanne, 1959.

Redding becomes Williamson VP

Bert J. Redding has been named vice president of Williamson Candy Company. He has been associated with the firm for thirty years in purchasing, and for the last year and a half as plant manager.

Lyman J. Houfek has joined Williamson as general sales manager. He came from the sales department of Armour & Company.

Sell $106.2 million of Confectionery and Chocolates in February

With about 343 manufacturers of confectionery and chocolate products reporting for the month of February, sales stood about equal with the January figure.

However, manufacturer-retailers sales increased 76% in February over the month previous, and were 1% better than February 1960. February 1961 sales were also 1% better than January sales for the chocolate manufacturers.

For the first two months this year poundage was up 6%, and dollar sales advanced 3% above those for the same period last year.

TABLE 1.–CONFECTIONERY AND COMPETITIVE CHOCOLATE PRODUCTS: DOLLAR SALES BY KIND OF BUSINESS

Item	Estimated sales of current month and comparisons		Estimated sales year to date	
	Feb. 1961 ($1,000)	Feb. 1961 from Feb. 1960	2 months 1961 ($1,000)	Percent change from 2 months 1960
Confectionery and competitive chocolate products, estimated total	106,246	− 1	212,277	+ 2
BY KIND OF BUSINESS:				
Manufacturer-wholesalers	83,363	− 1	169,969	+ 1
Manufacturer-retailers[1]	7,569	+ 1	11,860	− 1
Chocolate manufacturers	15,314	− 1	30,448	+ 4
TOTAL ESTIMATED SALES OF MANUFACTURER-WHOLESALERS BY DIVISION AND STATES				
New England	8,592	− 5	17,633	− 9
Middle Atlantic	27,154	+ 2	55,155	+ 5
N. Y. and N. J.	14,430	− 1	27,376	+ 2
Pa.	12,724	+ 5	27,779	+ 8
East North Central	30,140	− 5	60,031	− 2
Ill.	26,241	− 7	52,639	− 3
Ohio and Ind.	2,649	+16	4,713	+ 9
Mich. and Wis.	1,250	− 6	2,679	− 4
West North Central	3,845	+ 9	7,751	+ 9
Minn., Kan., S. Dak., and Neb.	2,298	+ 5	4,672	+ 2
Iowa and Mo.	1,547	+15	3,079	+21
South Atlantic	3,458	− 3	7,603	+ 2
Md., D. of C., Va., W. Va., N. Car., and S. Car.	1,645	− 4	3,309	− 1
Ga. and Fla.	1,813	− 1	4,294	+ 4
East South Central:				
Ky., Tenn., Ala., and Miss.	1,791	+ 2	3,525	+ 6
West South Central:				
Ark., La., Okla., and Tex.	2,550	+ 8	6,535	+12
Mountain:				
Ariz., Colo., Idaho, N. Mex. and Utah	943	+13	2,065	+16
Pacific	4,890	+13	9,671	+ 8
Calif.	3,975	+10	7,852	+10
Wash. and Ore.	915	+27	1,819	([2])

[1]Retailers with two or more outlets.
[2]Less than 0.5 percent change.

TABLE 2.–POUNDAGE AND DOLLAR SALES OF SELECTED MANUFACTURER-WHOLESALERS AND CHOCOLATE MANUFACTURERS, BY TYPE OF CONFECTIONERY

Type of product[1]	February 1961 Pounds (1,000)	February 1961 Value ($1,000)	First 2 months Pounds (1,000) 1961	First 2 months Pounds (1,000) Percent change from 1960	First 2 months Value ($1,000) 1961	First 2 months Value ($1,000) Percent change from 1960
TOTAL SALES OF SELECTED ESTABLISHMENTS	123,592	48,916	246,904	+ 6	101,378	+ 3
Package goods made to retail at:						
$1 or more per lb.	3,857	4,078	10,560	+ 2	13,080	+ 1
$.50 to $.99 per lb.	11,530	5,999	21,330	+21	11,126	+16
Less than $.50 per lb.	20,315	5,317	36,504	+10	9,588	+11
Bar goods	55,015	22,157	111,181	+ 1	44,692	− 3
5¢ and 10¢ specialties	14,353	6,210	27,772	+12	11,936	+ 5
Bulk goods[2]	18,522	5,155	39,557	+ 9	10,956	+ 9

[1]Selected group of large manufacturer-wholesalers and chocolate manufacturers report sales by type of product. Companies reporting such detail account for approximately half of the total dollar sales of manufacturers.
[2]Includes penny goods.

Data from monthly *"Current Industrial Reports"* of the U. S. Department of Commerce.

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this 1 lb. bag of gumdrops besides
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Nut firms merge

Peanut Products Co., Cranford, N. J. has merged with Bettman Nut Co. of the same city. Peanut Products Co., which is a division of Ramo, Inc., has headquarters in Des Moines, Iowa.

Lowe named to Credit group board

Ward B. Lowe, general credit manager of Curtiss Candy Co., Chicago has been elected to the board of directors of The Chicago-Midwest Credit Management Association for a two-year term. He is chairman of National Confectionery Manufacturers Industry Day at 65th Annual Credit Congress meeting in Denver, May 14-18.

Mars names Harrell Military representative

Mars Incorporated, Chicago, has appointed Wilson Harrell & Co., Inc., New York City, as representative for U. S. Army and Air Force Sales at home and abroad. Lester D. Lawson Co. continues to handle all Navy, Coast Guard and Marine Corps business for Mars.

Wander acquires American operations of Suchard

The Wander Company, Chicago, has acquired the American candy operations of The Suchard Company of Switzerland. Headquarters are at Ovaltine Food Products, division of Wander Co., Villa Park, Ill.

Hanson Candies expand; Johnson joins; firm relocates

John B. Johnson, who has been in retail sales for many years is new associate and president of Merle E. Hanson, Inc., candymaker of Chicago. In what has been described as a major expansion by Secretary-Treasurer Merle E. Hanson, the firm will move about June 1, from the Chicago location to 1422 Francis St., Ft. Wayne, Ind. The new quarters, which comprise 14,000 sq. ft. on one floor, are currently being remodelled. The Fort Wayne operation is expected to employ some 50 persons, whereas the Chicago unit employed 20.

Thurman new treasurer of 100-year old Schraffts

W. F. Schrafft & Sons Corp., Boston, Mass., candymakers since 1861, recently named Chris A. Thurman treasurer.

Candy from out of the west

From Out of the West, Inc., is the name of a new candy marketing company, owned and operated by Howard A. Elkins and Alice Wardlow. This new firm is located at the offices of Jolly Rancher Candies, in Colorado, and has been named national sales representatives for that company.

Elkins and Wardlow had both been associated with Mrs. Stevens Candies of Chicago.

E. J. Brach appoints marketing staff

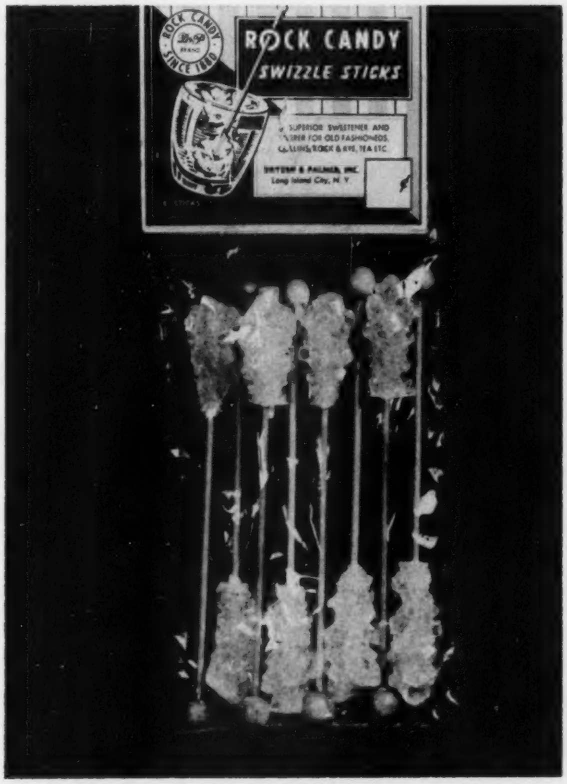
Burton N. Lowe, formerly advertising and merchandising manager of E. J. Brach & Sons, Inc., has been named Director of Marketing. Earl W. Bromstedt has been named merchandising manager, and Robert J. Urban is the firm's new advertising manager. Urban was formerly with Brach's advertising agency.

Crosse & Blackwell a Div. of Nestle

The Crosse & Blackwell Company, acquired by The Nestle Company a year ago, has just been integrated into the Nestle operation as an operating division. Management functions are being transferred to Nestle headquarters in White Plains.

The Crosse & Blackwell Company is particularly known for its jams, jellies and preserves. The firm is also the U. S. agent for Keiller candies from Scotland

New adaptation for rock candy



Dryden & Palmer, Inc., Long Island City, N. Y., is merchandising a cello bag of eight swizzle sticks, the ends of which have been imbedded in about 1½ inches of rock candy. The opposite end of each stick has a small round wooden ball. When packaged, opposing ends are side by side, making the product an attractive eye-stopper. Each stick-and-candy is approximately 6" long.

The head-to-foot label at end of cello bag is printed in coral and royal blue, is 3⅞" wide x 3⅛" deep. Suggested uses are shown on label front along with trademark and product identification. Our scout picked this up in Canada for 39¢.

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the Manufacturing Confectioner

Contents

May, 1961 Volume XLI—Number 5
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MANAGEMENT • TECHNICAL

NCA CONVENTIONEWS

June 11-15, Conrad Hilton Hotel, Chicago

PRODUCTION • EXHIBITION

Gala Finale Planned for 1961 Convention

Chicago (MC)—The Glenn Miller Band, under the baton of Ray McKinley, will play for the Candy Carousel Ball, the evening of June 15, in the Grand Ballroom of the Conrad Hilton Hotel. According to NCA Dinner Dance Committee Chairman Samuel C. Miller, Peerless Confection Co., the band will play during the banquet, for the entertainment part of the evening, and for the dancing which follows. Also, Chairman Miller reports that a good portion of the big wind-up event will be reserved for dancing.

Debbie Lang, the featured feminine vocalist with the Glenn Miller group will be on hand, as well as Lenny Hambro, saxophone soloist.

This is a capping climax to five big days of meetings. For example, an important industry event will take place on June 13. At a joint meeting of the National Confectioners Association and the Associated Retail Confectioners, the 1961 ambassadress for the candy industry will be presented by Theodore R. Sills & Co., public relations counsel for the Candy, Chocolate and Confectionery Institute public relations program.

Also, the exhibition of supplies and equipment for candy manufacturing is going to be a big one. And there'll be plenty of time to see it, without missing the important sessions. Exhibition hours:

Mon. 2:00 p.m. to 8:00 p.m.
Tues. 1:00 p.m. to 6:00 p.m.
Wed. 1:00 p.m. to 8:00 p.m.
Thurs. Noon to 5:00 p.m.

Three Interesting Social Functions Planned

Chicago (M C)—Aside from the heavy schedule of meetings, technical sessions and tour of the exhibitions during the 78th Annual Convention and Exhibition of National Confectioners Assoc., conferees will have some fun too. On Sunday evening, June 11, a "Riverboat" dinner party will be held in the Grand Ballroom of the convention headquarters hotel.

The annual NCA Golf Tourney is schedule for Monday, June 12, Elmhurst Golf Club.

Evening dinner dance on Thursday June 15, will feature a candy follies motif.

Candy Men Take A Candy Break

Mrs. Jane Mason, Leaf Brands, Inc., provided a sweet note at a recent meeting of the Sunday Night Get-Together Committee for the 1961 National Confectioners Association Convention, to be held June 11-15 in Chicago.

Taking a candy break with Mrs. Mason are (L to R) **Harold Flaig,** Mars, Inc.; Chairman **Richard B. Kimbell,** Kimbell Candy Co.; **Ralph Dombroski,** A. E. Staley Manufacturing Co.; Co-Chairman **J. C. Walsh,** American Licorice Co.; **Frank E. Puch,** Primrose Candy Co.; and **Fred T. Reid,** Reed Candy Co.

The Men Who Have Worked Hard to Make Convention Successful

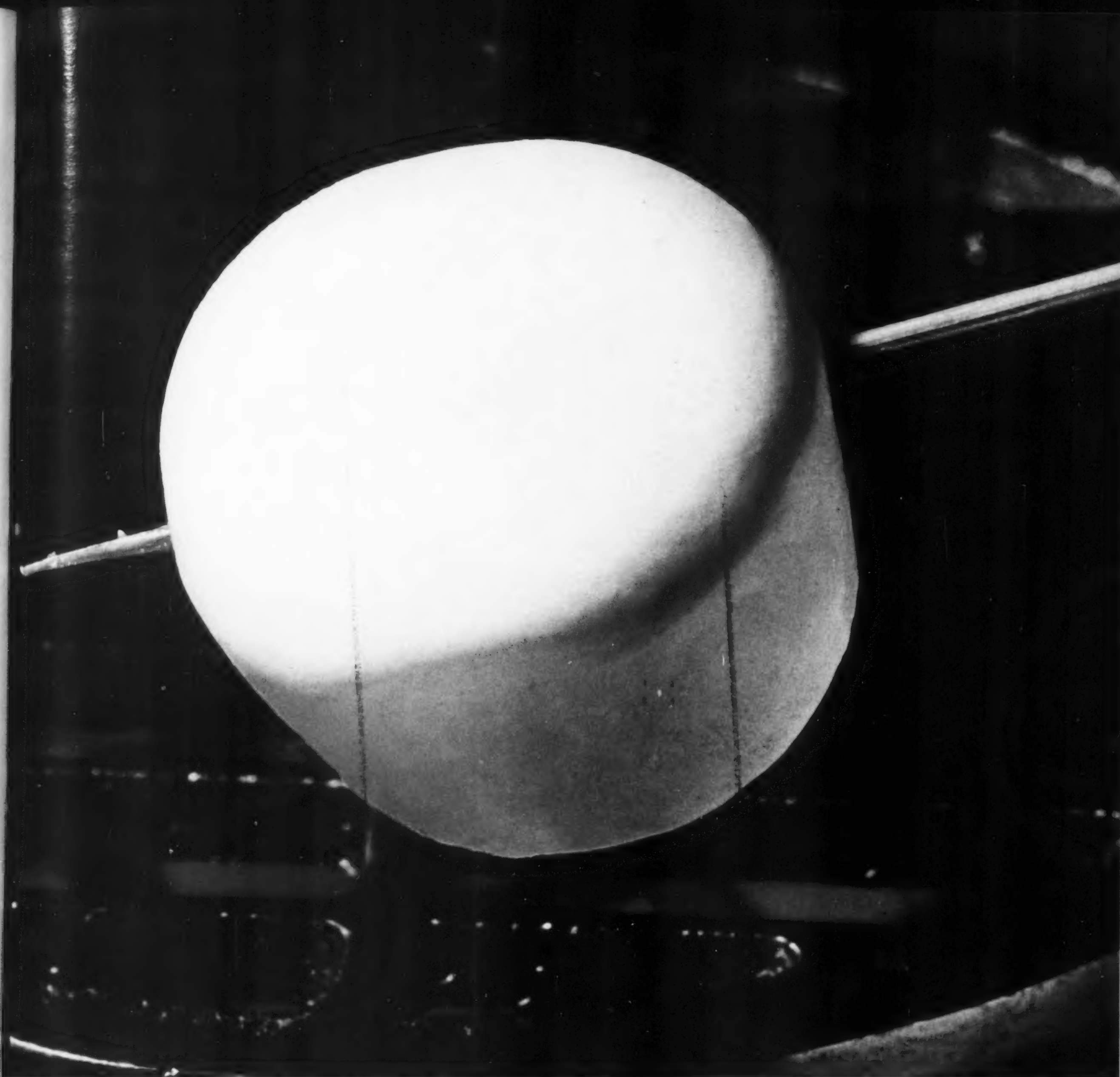
The 15 candy men, heading the 78th Annual Convention of the National Confectioners Association, met recently to discuss last minute details. The NCA will meet June 11-15 at the Conrad Hilton, Chicago.

Those at the meeting are (back row, l to r) **Frank R. Lawrence** (standing) Frank R. Lawrence Co., Ladies Entertainment Chairman; **Miss Themis Vasils,** NCA office manager; **Henry Blommer,** The Blommer Chocolate Co., and **Charles L. Smessaert,** Walter H. Johnson Candy Co., General Convention Co-Chairman and Chairman, respectively. **Douglas S. Steinberg,** NCA president is at right.

Seated (l to r) in the third row are: **Samuel C. Miller,** Peerless Confection Co., Dinner dance chairman; **Edward N. Heinz, Jr.,** Food Materials Corp., Dinner dance co-chairman and chairman of the NCA-AACT program; **Sam Shankman,** Leaf Brands, Inc., policy committee co-chairman; and **Robert J. Voss,** Voss Belting and Specialty Co., entertainment chairman.

Those in the second row (l to r) are **Richard B. Kimbell,** Kimbell Candy Co., and **J. C. Walsh,** American Licorice Co., chairman and co-chairman of the Sunday Get-Together; **Herb Knechtel,** Knechtel Laboratories, entertainment co-chairman; and **Adolph V. Stankus,** Hagley Candy Co., publicity chairman.

In the first row (l to r) are: **John G. Johnson,** Walter H. Johnson Candy Co., golf chairman; **James A. Dickens,** Williamson Candy Co., program chairman; and **R. N. Rolleston,** Williamson Candy Co., golf co-chairman.



SALES-WINNER!

Colorful Du Pont cellophane rings up more sales, cuts carton storage for Blumenthal

Blumenthal's candy sells faster in Du Pont MSD-54 cellophane. The mouth-watering goodness sparkles through the crystal-clear window . . . triggers mcre impluse sales. Colorful designs printed on the cellophane add "BB" brand impact and extra sales appeal to the candy. Another advantage—the use of printed cellophane to overwrap plain window cartons lets them work with a few basic cartons—reduce their inventory—and cut their storage costs.

MSD-54 is an ideal overwrap. New lower heat-sealing temperatures make it extra-efficient on machines. See how you, too, can win more sales, overwrap more profitably. Talk to your Du Pont Representative or Authorized Converter. Du Pont Co., Film Dept., Wilmington 98, Del.

DU PONT
Better Things for Better Living . . . through Chemistry

DU PONT cellophane


NO
MORE
OF
THAT!
Gown by Bonwit Teller

Letters

Likes MC

"For sometime I have been meaning to write you and your associates to congratulate you on the splendid new format of your magazine. In the April issue, we are all very pleased to see the excellent layout on Conventionews."

Douglas S. Steinberg, Pres.
National Confectioners Assoc.

There's more late news of the June 11-15 NCA Convention on the Conventionews page 11, this issue.

Approval

"My thanks and the thanks of all of us here at Delson for your editorial in the April issue of Manufacturing Confectioner. In a situation that has been full of unhappiness and frustration, it is very heartening to have expressions such as yours. These expressions and the encouragement we have had from other friends and colleagues have sustained us in what we hope will be a successful defense of our principles."

Armin N. Schaper,
Delson Candy Co., Inc.

Agrees

"I agree whole heartedly with your editorial regarding the new insignia for the NCA" (What's the Goal?, March p. 11).

"I find it difficult to imagine how a group of men constituting our Board of Directors would agree to it. I am sure if I were a member I would not have given my consent.

"I think it is entirely meaningless. It is difficult to decipher and I doubt whether many members will make use of it."

W. C. Dickmeyer, Pres.
Wayne Candies, Inc.

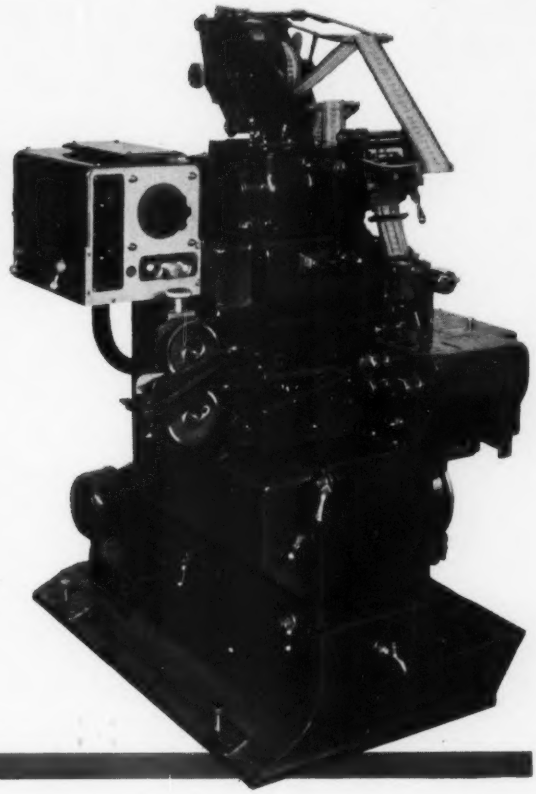
"Just a note to let you know that I feel you had a very good editorial regarding the NCA Emblem."

Bill Beich
Paul F. Beich Company

New High-Speed, 750 per Minute

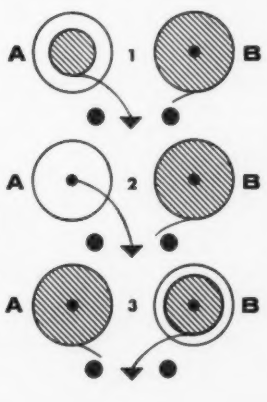
Forgrove 42C cut-and-wrap

...with Continuous Paper Feed



This new Forgrove 42C cut-and-wrap machine gives you higher speeds—up to 750 pieces a minute. With toffee, caramel or high boiled sugar in a plastic state, you get neat, tight twist wraps on cylindrical or rectangular shapes.

Model 42C now features continuous paper feed, with a paper splicing unit and new rotary paper knife. Electric speed controls and speed indicator are provided. A simple handwheel adjustment regulates the exact number of pieces per pound. Candy rope is shaped and sized by easy-to-clean infeed rolls, cut with a guillotine knife that gives a cleaner end, reduces chips. You may wrap with plain or printed cellophane, waxed paper or reinforced foil outer wrap, with waxed paper or foil inner wraps optional.



New continuous paper feed. Forgrove 42C mounts two paper reels. As roll A runs out or breaks (1), roll B is ready to take over; (2), Roll B provides wrapping material and (3), roll A is refilled and ready for use.

Forgrove Model 42C will handle the following size range:
Rectangular—5/8" to 1½" long, ½" to 7/8" wide, 5/16" to 5/8" thick.
Cylindrical—5/8" to 1½" long, ½" to 5/8" diameter.

For full information on this new, high-speed Model 42C or any other candymaking and wrapping equipment in the complete Forgrove line, call your nearest Package representative.

PMMI

PACKAGE

PACKAGING IS PART OF YOUR PROFIT PICTURE

PACKAGE MACHINERY COMPANY, EAST LONGMEADOW, MASS.
NEW YORK • PHILADELPHIA • ATLANTA • BOSTON • CLEVELAND • CHICAGO • KANSAS CITY
DALLAS • HOUSTON • LOS ANGELES • SAN FRANCISCO • SEATTLE • TORONTO • MEXICO CITY

Sole agents in the U.S., Canada and Mexico for all Forgrove candymaking and wrapping machines.

"You are 100% right!" (What's The Goal?)

ERNEST ABELES
The Sweets Company of America

"Congratulations!

"I just want to let you know how much I appreciated your apt editorial in MC. (What's the Goal?)

"Your article certainly hits home and I hope that many confectioners will read it."

CLAYTON A. MINTER, JR.
Minter Brothers, Inc.

"I thoroughly enjoyed your editorial (What's the Goal?) in the March issue of your fine magazine, but I think you missed a few NCA's. For instance, there are the following official organizations: National Cashmere Association, National Charcoal Association, National Coffee Association, National Constructors Association, National Costumers Association, National Creameries Association.

"When it comes to NRA's let's not forget the good, old National Rifle Association, as well as the National Reclamation Association and the National Renderers Association . . . Enough of this tomfoolery . . . your reaction to the new NCA insignia is very well taken and very well timed."

WM. S. CARVER
Fred S. Carver Inc.

Our Error

In the February '61 issue of MANUFACTURING CONFECTIONER, *we inadvertently failed to credit Union-Bag Camp Paper Corporation's Chicago Box division for the design of Williamson Candy Company's shipping cartons. Also the boxmaker worked with Williamson in over-hauling the code-printing system.*

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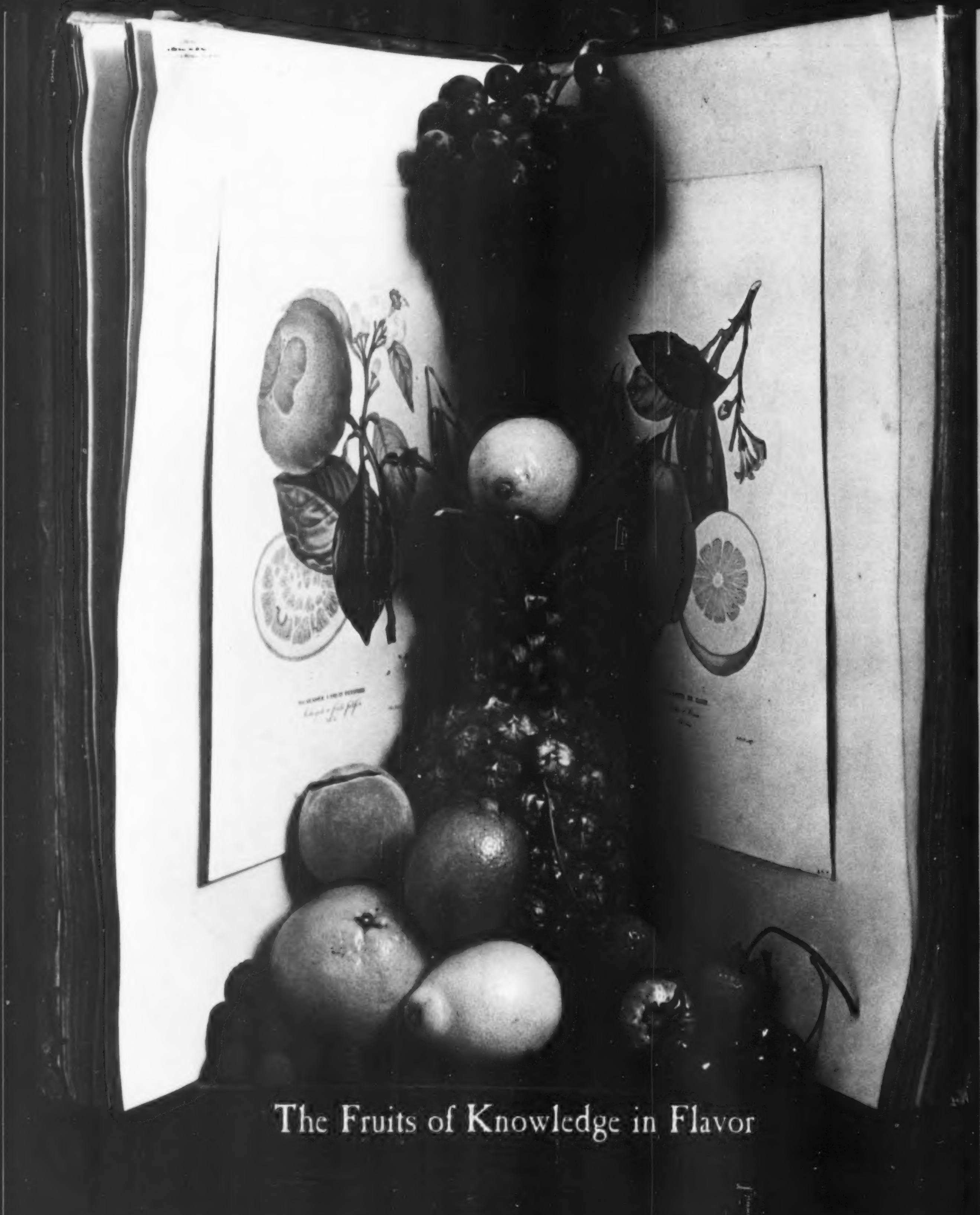

The Fruits of Knowledge in Flavor

Labora

for M

the Manufacturing Confectioner

May, 1961

Volume XLI—Number 5

PMCA Production Conference

Formation Studies of Fat Bloom and Method of delaying it

by Dr. Ing. J. Kleinert,
Laboratory of Lindt & Sprungli AG, Kilchberg ZH

Fat bloom probably existed ever since chocolate was first manufactured. Regarded as a problem in crystallography the bloom itself is quite a remarkable structure and looked at under the microscope it becomes an object of considerable beauty.

Unfortunately, attractive though these crystals are in themselves, they make chocolates appear old and stale, once they have grown larger than a certain critical size. Fat bloom therefore costs the manufacturer both money and goodwill. Many industrial laboratories and some well known research institutes are therefore investigating the causes of fat bloom and methods of preventing, or at least, delaying it.

The problem therefore is of general interest to the chocolate industry and in recent years a number of very interesting and remarkable papers have been published on this subject (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15 and 24). Closer examination, however, shows that the authors differ to some extent in their views of how fat bloom is caused. At present there appears to be no general method of preventing fat bloom which is equally effective for all filled chocolates regardless of the center composition or of the methods of tempering. Even Span 60 (sorbitan monostearate) and Tween 60 (polyoxyethylene monostearate) have been disappointing in practice in spite of the great hopes which were at one time placed on them.

In our laboratory we have also done a good deal of work in recent years, in order to try to find an effective method of preventing fat bloom. We have obtained some useful and to some extent very promising results. These were communicated, to members only, at the 13th scientific conference at the Institute for Food Technology and Packaging in Munich. However, all progress is based on constant give and take and we therefore feel that this work should now be fully published.

In this paper we will discuss, with reference to the literature, factors likely to be involved in the formation of fat bloom. We will also give experimental

results of our own to show how bloom formation can be delayed.

The causes of fat bloom

Fat bloom in chocolates can be due to a variety of causes. This is apparent from the literature and was confirmed by a comprehensive series of experiments which we carried out. The whole problem is extremely complex and there is no common denominator. Therefore it seems essential to start by going into a number of factors which are dealt with only slightly or not at all in the literature.

Our work was carried out on chocolates having as a center two layers of nut crunch with marzipan in between. (See Figure 1.) Several years' practical experience has shown that this sandwich type of center is particularly liable to fat bloom.

1. Tempering centers and moulds

It is well known in the trade that centers must be warmed slightly before enrobing and moulds before filling. All the same, manufacturers often do not pay enough attention to bringing their centers to the right temperatures for enrobing. Our experiments have shown that seeds of fat bloom are often sown at this stage. We found that unsatisfactory center tempering may promote fat bloom in two ways:

A. If the temperature of the centers is not properly adapted to that of the coating.
B. If the centers become moist during tempering due to unsatisfactory ambient conditions.

A. Tempering the center

In practice this is generally done by storing the centers in the enrober room for some time before they are actually enrobed. Suitable tempering is essential if one wants to obtain a chocolate coat which will maintain a high gloss on storage. However, if the change in temperature is too violent or the ambient conditions are unsatisfactory, this warming may lead to deposits of moisture on the pieces and this in turn can cause fat bloom at a later stage. This applies especially to fat based centers. The latter nowadays are often manufactured and stored in rooms which are artificially cooled. Furthermore, these fat based centers, such as praline or nut crunch, are in any case poor heat conductors and it takes a good deal of time before the temperature is equilibrated right through to the middle. Since these centers are in any case particularly prone to fat bloom, one can see how essential satisfactory tempering is.

One can prove this very readily by passing centers at 18° C (64.4° F) and ones at 28° C (82.4°F) through an enrober simultaneously. By the time they emerge from the cooler the differences are quite obvious since the colder pieces have a dull surface.

The coating on the cold pieces also shows a multitude of fine hair cracks. These are generally due to sudden setting by the cold centers but may also be due to too much external cooling. In any case one must remember that conventional cooling by cold air is liable to set up a strain in the coating, the extent of the strain depending on the temperature gradient. These strains can cause hair cracks and these in turn promote bloom if the centers are of a fatty, bloom-promoting type. For maximum resistance to fat bloom the centers should therefore be tempered in a suitable way and after enrobing they should be cooled as gently as possible. Radiant cooling therefore may be very useful in the fight against fat bloom. By this method the chocolates are cooled evenly by radiating their heat and the surrounding air is almost motionless. Consequently tensions in the chocolate and hair cracks are largely prevented.

The prevention of fat bloom by pre-warming the centers was neatly illustrated by Sachsse's (9) experiments. By adding cold hazel nuts to a well tempered plain chocolate he was able to show that fat bloom formed quite rapidly above and around the nuts. This is a common phenomenon and is probably well known to every chocolate manufacturer. It is commonly believed that only the nut oil contributes to the formation of fat bloom. Sachsse (9) showed that this is not so by mixing pre-warmed hazel nuts into untempered chocolate and then tempering the mixture. The bars were moulded and stored for several months. No fat bloom formed either around or above the nuts. We were able to repeat Sachsse's results.

One can deduce from this that this fat bloom promoting factor is also present when cold centers other than nuts are used.

In any case we have shown above that pre-heating the centers and careful cooling will help to prevent fat bloom.

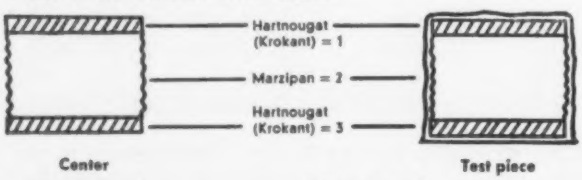
B. Moisture content of the centers

Cerbulis, Clay and Mack indicate in a paper (14) that chocolates with moist centers are much more prone to fat bloom than ones with dry centers. Centers with a high fat content therefore should delay fat bloom since they contain virtually no moisture. This implies a correlation between the moisture content of the centers and the speed of blooming.

We carried out a large number of experiments, using a variety of centers. We were able to confirm the observations of Cerbulis, Clay and Mack (14) for some centers, particularly those based on fat and burnt sugar. With these, moisture definitely promoted fat bloom. This correlation, however, does not hold for centers with a high water content such as fondants and marzipan.

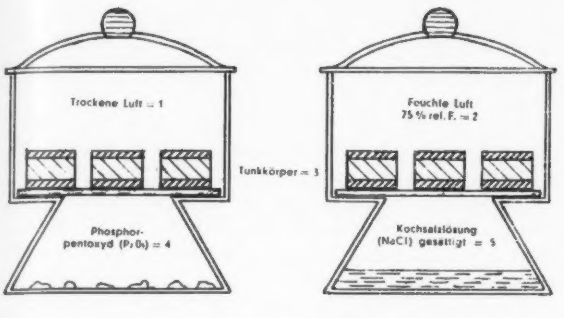
The sandwich test centers in Figure 1 show the effect of moisture on fat bloom very clearly. Bloom originates at the junction of marizpan and nut crunch and slowly penetrates to the top of the piece. As soon as moisture has diffused from the marzipan

Figure 1. Sandwich test centers which were used for certain experiments on the formation of fat bloom.



1 = Nut crunch.
2 = Marzipan.
3 = Nut crunch.

Figure 2 Diagram shows the arrangement for drying and moistening the surfaces of the centers.



1 = Dry air.
2 = Moist air 75% R. H.
3 = Centers.
4 = Phosphorus pentoxide (P_2O_5).
5 = Saturated salt (NaCl) solution.

through the nut crunch plate, fat bloom begins to cover the top of the chocolate. By way of confirmation we carried out simultaneous experiments on the individual components. Marzipan and nut crunch separately were enrobed at the same time and with the same coating as the test centers. Several runs were carried out at different times of the year and the result was always the same. Under normal storage conditions the test pieces had always bloomed within 2 months. The chocolates with the individual components had not changed in appearance after 6 months.

These nut crunches contain both caramelized sugar and fat. It would appear, that the latter is largely in a free state and in the sandwich pieces is pushed outwards by moisture diffusing in from the marzipan.

Now if chocolates are cooled abruptly, hair cracks and pores are always produced in the coating, through which this nut oil can penetrate to the surface. There it crystallizes or forms layers on existing crystals which therefore become larger than the critical size and become visible as fat bloom.

On the other hand we have found experimentally that these chocolates do not bloom if they are stored for a few hours in warm air at 32° C (84.6° F). We believe that warm storage tempering stabilizes the chocolates by forming a continuous film of fat in the coating.

C. Surface humidity of the centers

The experiments with the sandwich test pieces showed that for some center formulae moisture was a factor which determined whether fat bloom occurs or not. There are, however, other centers, such as marzipan, fondants, liqueurs with crust, etc. which contain appreciable amounts of moisture but show excellent resistance to fat bloom when enrobed in plain chocolate. Other factors, therefore, must also be involved. In order to investigate these, we set up the following experiments, using nut crunch and sandwich centers:

1st. group:

The surface of the centers was dried thoroughly by storing them in a desiccator over P_2O_5 for 24 hours at 18/20° C (64.4/68.0° F) (see Figure 2). Then, without any prewarming they were immediately coated with a well tempered standard chocolate.

2nd group:

In order to obtain the optimum surface moisture, centers were stored for 24 hours in a desiccator over a saturated NaCI solution at 75% R. H. and a temperature of 18/20° C (64.4/68.0° F). They were then immediately enrobed with standard chocolate.

3rd group:

The centers were stored for 24 hours in the laboratory at a R. H. varying between 50 and 60% and a temperature of 18/20° C (64.4/68.0° F). They were then, without prewarming, given a first coating of standard chocolate. From the end of the cooler they were returned, still cold, to the enrober and coated for a second time with the same chocolate.

4th group:

The centers were treated as for group 3 but were kept at 28° C for 5 hours between 1st and 2nd coat.

The chocolates from all these runs were then stored under the same climatic conditions and the shelf life was examined at intervals. The results are shown in Table 1.

Contrary to expectation therefore, bloom formed equally quickly on chocolates having centers with a very dry surface and those with a very damp surface. The former, however, had a rather more shiny surface right from the start.

This series of experiments also shows that moisture

Table 1

The storage of chocolates from groups 1 to 4. Storage temperature 18—20° C (64.4—68.0° F) — Relative Humidity 50—60%

Examined after:	Appearance of the chocolates			
	1st group	2nd group	3rd group	4th group
Start	Good gloss, no hair cracks	Glossy, with many hair cracks	Dull surface, with hair cracks	Good gloss, no hair cracks
1 month	Good gloss, no hair cracks	Glossy, with many hair cracks	Dull surface, with hair cracks	Good gloss, no hair cracks
2 months	Good gloss, no hair cracks	Glossy, with many hair cracks	Dull surface, with hair cracks	Good gloss, no hair cracks
3 months	Good gloss, no hair cracks	Glossy, with many hair cracks	Dull surface, with hair cracks	Good gloss, no hair cracks
4 months	Slight traces of bloom at marzipan—nut crunch interface	Slight fat bloom at marzipan—nut crunch interface	Top starting to bloom	Good gloss, no hair cracks
5 months	Definite fat bloom at marzipan—nut crunch interface	Definite fat bloom at marzipan—nut crunch interface	Whole top covered in bloom	Good gloss, no hair cracks
6 months	Definite fat bloom at marzipan—nut crunch interface. Slight bloom on top of chocolate	Definite fat bloom at marzipan—nut crunch interface. Slight bloom on top of chocolate	Whole chocolate dull and covered in bloom	Good gloss. Slight bloom and some cracks at marzipan—nut crunch interface

in the centers can lead to fat bloom under certain conditions.

Our sandwich center, however, is not suitable for demonstrating the effect of surface moisture on fat bloom. This is because the moisture concentration at the surface rapidly equilibrates with that of the marzipan layer.

However, there is a good correlation between surface moisture and fat bloom when ordinary nut crunch pieces are used as centers. Results for this type of center agree with the observations made by Cerbulis, Clay and Mack (14). We can, therefore, conclude that moisture may contribute to fat bloom formation under certain conditions and moisture, therefore, is one of the factors which must be considered in any method for preventing fat bloom. Our experiments were continued systematically and we found that moisture only promoted fat bloom if the centers were composed of mixtures of fat and caramelized sugar in some form. These are hygroscopic and the surface frequently picked up moisture during temperature equilibration. This in turn may trigger off fat bloom formation at a later stage. Surface condensation has roughly the same effect and is liable to occur in summer when centers are brought for temperature equilibration from a cool production department into the enrober room which is considerably warmer. This type of surface wetting is not normally sufficiently pronounced to be visible to the eye and is, therefore, generally ignored in practice. The fact that some chocolates are more prone to fat bloom in the summer is put entirely to summer storage conditions though this is only partly true. In fact the same chocolates will also bloom if storage conditions are perfect and elevated temperatures therefore are not the only cause. Condensation on the centers can be prevented by airconditioning the manufacturing departments. The relative humidity for this purpose should be kept as low as possible, the limiting factor being the comfort of the employees.

2. *Polymorphism of cocoa butter*

The literature (2, 5, 9, 10 and 24) shows that cocoa butter can crystallize in four polymorphic forms, depending on the cooling conditions. The forms differ in their melting points. Fat crystals with high energy potential tend to change into the form with the lowest energy which is therefore the most stable one. During these changes appreciable amounts of heat are liberated which correspond to the differences in the melting data between the old form and the new one. The energy thus liberated, causes a temporary increase in the amount of liquid phase and if enrobed chocolates are cooled too rapidly this is liable to set up stresses in the coating. These stresses can be shown to be a bloom promoting factor. One can largely prevent them by tempering the coating well and cooling it so as to avoid setting up any stresses. These two factors, correct tempering and slow cooling, are so very important for preventing fat bloom, that we will now discuss them in detail.

A. Tempering correctly

Chocolate should have a hard, clean break, a good shine and a good shelf life. These desirable properties can only be obtained by tempering the chocolate well and cooling the enrobed pieces under suitable conditions. For optimum results one must have a clear idea of the structural conditions within the molten chocolate. Frequently, however, chocolates are tempered by quite empirical methods without any knowledge of the physical and crystallographic changes which occur. Often this important step is left entirely to machines.

Chocolates and coatings are complex systems, in that non-fatty components are dispersed in a continuous fat phase. At the temperatures which can be used in practice, one can only influence their state of aggregation by acting on the fat phase. Tempering, therefore, only affects the fat. Fats, like many other compounds, liberate heat on crystallizing. Some well known fat chemists (14), (16) have shown that the stability and the final size of the fat crystals in the chocolate can be influenced by the cooling and mixing conditions. The fat crystals become smaller and more numerous with more intensive cooling and mixing. To get a chocolate with good gloss, compact texture and hard snap, these crystals must not only be minute, they must also be present in as stable a form as possible. Fat bloom in filled chocolates can only be prevented if there is a complete absence of gaps in the fat film. This means that the non-fatty components of the coating must have been throughly dispersed in the fat during conching and must be completely surrounded by fat. There is, therefore, a correlation between conching and fat bloom. This correlation must not be forgotten since it affects the properties and the behavior of the continuous fat phase and therefore the stability of the whole system, i. e. the coating on the center.

When using tempering machines on coatings it is wrong to try and increase the throughput by using low temperatures. This leads to an excessively high proportion of unstable fat crystals and hence to bloom. Many makers of modern tempering machines can be criticised for ignoring the laws of crystallography and constructing their machines so as to give maximum throughput rather than optimum tempering.

Tempering releases large amounts of heat which have to be removed but the jacket temperatures used for doing so are often much too low. We have shown in detail in a previous communication (10) that a solid layer of chocolate is formed on the inner wall of the tempering machine if this wall is too cold. The cocoa butter in this layer is present in an unstable polymorphic form having been temporarily super-cooled owing to the shock treatment. The stirrers now serve to scrape off this solid layer continuously and then to distribute these unstable crystals throughout the chocolate. The proportion of unstable fat crystals is increased considerably towards the end of tempering. This is because the chocolate is used for enrobing at temperatures which are below the melting point of cocoa butter and at these temperatures unstable crystals are no longer able to melt rapidly enough. In the end, therefore, many of these unstable crystals go into the solid chocolate.

Good tempering on the other hand does not begin when the chocolate is cooled; it starts when the blocks

of chocolate are melted. Fats, of course, are a mixture of various glycerides. Therefore they do not have a sharp melting point but a melting range, the extent of which depends on the glyceride composition. In order to start tempering from a well defined state one has to melt the fat completely, i. e. without leaving any nuclei. This is done by heating at least to 50° C (122.0° F) with constant stirring. Cocoa butter heated carefully (i.e. without stirring) to 38°C (100.4° F) still contains crystals visible under polarized light.

We photographed the same field at various temperatures and found that the amount of crystalline material is reduced with increasing temperature but crystals have not completely disappeared at 38° C (100.4° F). As a result of physical and microscopic examination one can conclude that the following factors are important for good tempering.

a) The chocolate must be heated to at least 50° C (122.0° F) with stirring in order to melt the fat phase completely.
b) Correct time and temperature conditions are essential for producing crystal nuclei of the stable polymorphic form.
c) Supercooling below 25° C (77° F) even temporarily, must be avoided while tempering. Such supercooling can occur where the chocolate is in contact with the machine (walls, stirrers, etc.)

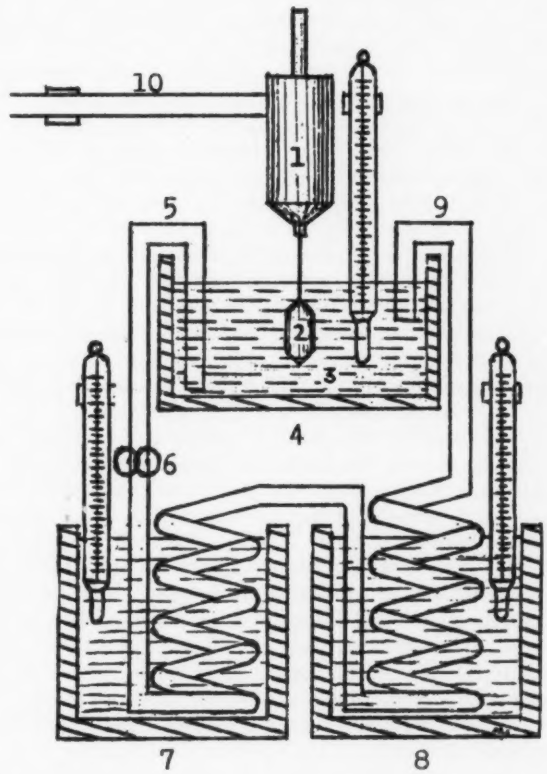
The difference between precipitous and gentle tempering is seen very clearly under the microscope.

We can therefore see that tempering must give quite definite crystallographic conditions in order to produce coatings with a good shine and shelf life. The amount of literature on tempering chocolate is so large as to be confusing. We, therefore, think it worth while to describe a method of tempering which is suitable from a physical and crystallographic point of view.

a) The chocolate is melted in a melting kettle with constant stirring, until the temperature is at least 50° C (122° F). A minimum of 50° C (122° F) is particularly important when melting large blocks of chocolate. When these large blocks are made, crystals of the highest melting polymorphic form are always produced owing to the poor heat conductivity of chocolate. These crystals must be completely melted otherwise they may cause tempering faults.
b) The chocolate is then cooled carefully to 33–34° C (91.4–93.2° F) again with constant stirring and ensuring that no local supercooling takes place at points in contact with the tempering machine. The cooling water in the tempering machine must not be below 25° C (77.0° F).
c) While the chocolate is thus being cooled in a melting kettle or other suitable vessel, the storage container of the enrober should be pre-warmed to the required working temperature which is in the range of 30° C (86.0° F).
d) The amount of chocolate from (b) which is needed to fill the storage container is then transferred to a suitable mixer and seeded with 3–5% of a crystal slurry. The latter was previously prepared from the same batch of chocolate.

Alternatively grated chocolate can be used for

Figure 3. Schematic diagram of the laboratory apparatus, used to demonstrate the correlation between temper (i.e. proportion of crystalline fat) and viscosity of chocolate or cocoa butter.



Legend:

1 = Viscometer used for measuring and control.
2 = Cylinder of viscometer.
3 = Container for cocoa butter or enrober chocolate.
4 = Testing vessel, can be controlled by thermostat.
5 = Tube for drawing off chocolate. This corresponds to the chocolate lost on the centers in a real enrober.
6 = Circulating pump.
7 = Melting zone to obtain melted chocolate.
8 = Cooling zone for pre-cooling the chocolate gently to 33–34° C (91.4–93.2° F).
9 = Addition of pre-cooled but untempered chocolate.

Notes to Figure 3

aa) During enrobing, chocolate is constantly removed from the enrober by the centers which are being coated. This is simulated in our apparatus by pumping chocolate continuously from our storage container (4). In order to economize the material under test (cocoa butter, chocolate, etc.), this is completely melted in the heater (7).
bb) The melted material is then carefully, and without supercooling, brought down to 32–34° C (89.6–93.2° F) in the cooling zone (8). This is then put back, being the same amount as was removed from the tank. Thus the temper of the batch is kept constant.
cc) The centers are, of course, enrobed at a temperature which is below the melting point of cocoa butter. Any rise in the viscosity of the cocoa butter or coating must therefore be due to an increase in the numbers of fat crystals, providing always that a constant temperature is maintained in the heated storage container (4) or the enrober tank. This viscosity increase or overtemper can be measured. By using a viscometer as a measuring and control device the addition of cooled untempered chocolate can be adjusted so as to keep the viscosity constant.

seeding. This material must be prepared from a homogenous block of chocolate, which has been stored for some time and was well tempered before moulding. In either case the seeding material must be mixed well into the rest of the batch.

e) The seeded chocolate is then transferred to the storage container of the enrober and coating is started immediately.

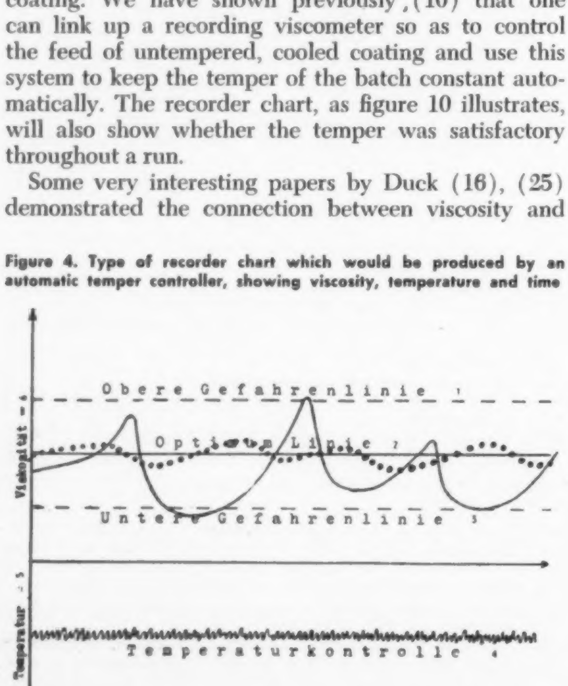
f) The temper of the chocolate in the enrober is kept constant by constant addition of untempered but carefully cooled chocolate. The latter dilutes the fat crystals and is therefore liable to reduce the temper too much, temporarily at least. This results in thinner chocolate coats on the centers until the temper is correct again. We have shown in a previous paper (10) that the number of fat crystals rises very rapidly indeed owing to the constant movement of chocolate in the enrober. At a constant temperature this increase in crystalline fat causes a continuous rise in viscosity, i. e. the chocolate becomes over-tempered. As a result the chocolate coating on the centers becomes thicker, the chocolate consumption goes up and the final products are over weight.

There is, therefore, a correlation between the temper (i. e. the amount of crystalline fat) and the viscosity of a chocolate. This can be demonstrated by means of a simple laboratory instrument shown in Figure 3.

One can thus measure the optimum temper for any coating. We have shown previously (10) that one can link up a recording viscometer so as to control the feed of untempered, cooled coating and use this system to keep the temper of the batch constant automatically. The recorder chart, as figure 10 illustrates, will also show whether the temper was satisfactory throughout a run.

Some very interesting papers by Duck (16), (25) demonstrated the connection between viscosity and

Figure 4. Type of recorder chart which would be produced by an automatic temper controller, showing viscosity, temperature and time



1 = Upper danger line
2 = Optimum line
3 = Lower danger line
4 = Temperature control
5 = Temperature
6 = Viscosity
7 = Hours

LEGEND:
.... Temper regulated continuously
——— Temper regulated intermittently

temper of chocolate and confirmed our findings completely. By way of correction we ought to add here that our method is also based on the proportion of liquid to crystalline fat in the molten chocolate.

g) The chocolate may become over tempered owing to bad management, machine stoppages or other causes. If this happens all the chocolate in the enrober tank must be remelted and the whole tempering process restarted.

B. *Suitable cooling methods*

One can demonstrate experimentally that severe cooling and big temperature gradients increase the tendency to bloom in coated chocolates. At present it is not quite clear whether this is primarily due to the formation of unstable fat crystals or whether other factors are also involved. However, as we know from inorganic chemistry, it takes time to build up crystal lattices. Crystallizing the fat in chocolates also takes time and this fact must not be ignored. Excessively rapid cooling leads to two defects. Firstly, the continuous fat phase in the chocolate solidifies in an unstable form and secondly, the contraction sets up appreciable pressures acting on the center. As a result hair cracks are formed in the coating and fat from the centers is pressed onto the chocolate surface. There it forms layers on existing fat crystals or forms new and very small crystals; thus establishing the best possible conditions for subsequent fat bloom formation. These conditions particularly favor bloom if the storage temperature rises temporarily to 26–28° C (78.8–82.4° F), not a rare event at our latitudes. At these temperatures more of the fat becomes liquid and the surface crystals, to use Hettich's (17) expression, draw this liquid fat up rather like so many wicks. This fat later sets on the surface. An ever thicker carpet of crystals is formed on the surface. Eventually the crystals become thick enough to be visible with the naked eye and then the chocolate has bloomed. In order to minimize fat bloom, therefore, chocolate must be cooled gently and carefully as well as being well tempered. Cooling should be slow enough to allow the fat crystals to grow into good lattices which interlock without any gaps. Physical considerations therefore lead us to prefer a method of cooling which is largely based on radiating the heat away. The method suggested by Morgan (18) and Mills (19) is of particular interest for this. Here the latent heat which is liberated when the fat in the chocolate solidifies, is absorbed by non-reflecting, dull, black surfaces. A circulating coolant serves to remove the heat from these. Forced air circulation is deliberately omitted in the cooler though slight thermal currents are set up as the air is heated by the cooling chocolates. This method has been called "radiant" cooling, in our opinion erroneously so. According to Morgan and Mills it acts in depth unlike the more normal convection cooling. According to these authors the heat rays penetrate the chocolate and the pieces cool from inside as well as from the surface. One therefore largely avoids tensions which can lead to hair cracks.

We have experimented with this for some years and found that chocolates and other small pieces can be cooled very successfully by radiation. If a well tem-

pered chocolate has been used, the pieces have a good shine and are remarkably bloom-resistant. We, therefore, decided to investigate whether one could see any differences microscopically between chocolates cooled in the normal way and ones cooled by heat radiation, both sets of samples having been prepared from the same well tempered batch. For this purpose chocolate was well tempered without supercooling and moulded into small pieces 5 mm. deep and 30 mm. in diameter. Some were then cooled simultaneously by both methods.

Comparing the micrographs we find that the chocolate cooled by heat radiation has a finer and more uniform crystal structure. The latter also produces a micrograph which is lighter in color. Both were taken with the same lamp and aperture and the lightness of one is therefore directly related to the finer crystal structure. This difference is even more pronounced when one is actually looking down the microscope. When taking photos the exposure has to be adjusted to the speed of the film and the differences are toned down somewhat.

Gentle cooling by heat radiation therefore is an effective prophylactic measure against fat bloom. There are also, however, other sound reasons in favor of cooling chocolates and other small chocolate goods by heat radiation. They are:

a) According to Mills (19) heat exchange by radiation is proportional to the fourth power of the absolute temperature. It is therefore quicker than heat exchange by convection. One can therefore keep coolers shorter and save space.
b) No air is cooled and therefore there is no need to get rid of heat of condensation (from the moisture in the air). This can be quite appreciable, depending on the climate and there is thus a saving in energy.
c) Normal convection systems suffer from losses of cooling air and attending side effects. No such losses can occur since slight thermal air currents only are formed during cooling by radiation. As a result energy is saved and the personnel are not exposed to blasts of cold air.
d) In contrast with convection cooling this method removes hardly any moisture from the work during cooling, again because there is very little air movement in the cooler.
e) There is no difficulty in constructing suitable coolers, specially designed to absorb heat.
f) Such coolers are appreciably cheaper to build than conventional coolers. Furthermore their construction is very simple and as a result running and maintenance costs are lower.

Unfortunately our knowledge of this interesting method of cooling and its application to chocolate cooling are very fragmentary. We believe that the chocolate industry and the research institutes should get together as a matter of urgency and carry out some fundamental research on the subject. We are, therefore, very glad that the Institute for Food Technology and Packaging in Munich has carried out some of this work (26). Their conclusions, however, do not altogether agree with observations made in industrial practice and this research should therefore be continued by scientific institutes.

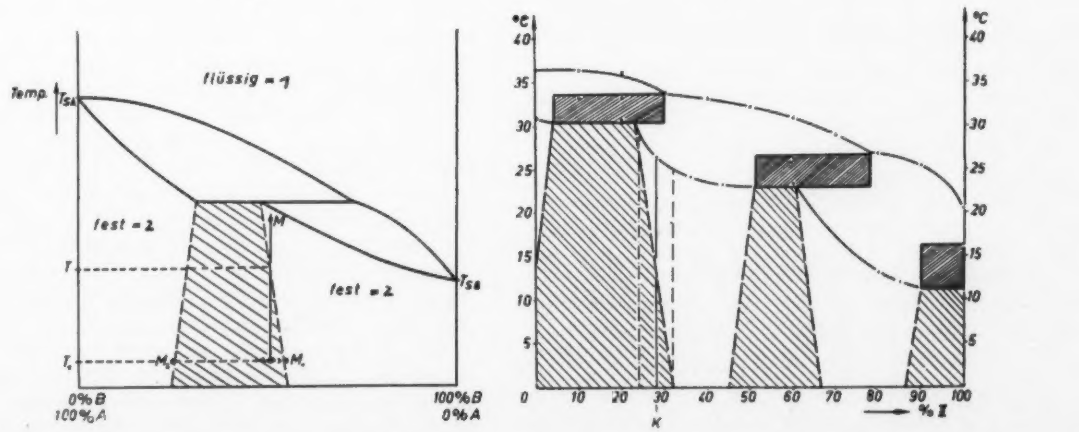
3. Limited miscibility of cocoa butter glycerides

Cocoa butter is a mixture of several component glycerides which are completely miscible in the molten state. However, Becker (15) has shown that in the solid state they behave as if they were only partly miscible. On cooling cocoa butter, mixed crystals are formed, their composition depending on the temperature. Figure 6 shows a simplified two component system according to Becker (15) and illustrates that cocoa butter forms mixed crystals on cooling and that these can decompose as the temperature falls further and enters a metastable region.

The dotted lines on either side of the line marked K in figure 6/B indicate that cocoa butter crystals can never be completely homogenous in composition. What happens in practice is that the triglycerides with

Figure 6. A simplified two component phase diagram according to Becker (15) showing components I and II.

A. **B.**



Phase diagram of two components only partly miscible in the solid state. The shaded part is the metastable region or miscibility gap.
1 = liquid 2 = solid

Two component phase diagram of cocoa butter with components I and II. K is the average composition of a cocoa butter with an iodine value of 37.5

the long chain fatty acids diffuse more slowly than those with short chain fatty acids. When cocoa butter solidifies, therefore, the crystals tend to have a center of higher melting triglycerides and a skin of lower melting triglycerides. As these layered crystals are cooled, more and more layers will pass into the metastable region. As figure 5/A shows they will eventually decompose into two mixed crystals of composition M_1 and M_2. Becker believes that this decomposition is the real cause of fat bloom. According to his system, bloom crystals would have a higher proportion of group I triglycerides, containing not more than one oleic acid chain. These crystals would, therefore, have the higher melting point which Easton and Moler (12) found usual in fat bloom and they would also have a lower iodine value. Becker's theory is logical and ingenious as well as being easy to follow. However, as we have already mentioned in our lecture at the 14th Conference of the Institute for Food Technology and Packaging in Munich we cannot agree with it. In spite of its ingenuity, the theory cannot be reconciled with certain practical observations. However, we do not doubt that metastable regions can be formed in a complicated system such as cocoa butter and that these can cause fat bloom.

According to this theory chocolates with centers of pure cocoa butter would be bound to bloom after a certain period of storage at 20° C (68.0° F). To check Becker's theory, therefore, we carried out the following experiment. Cocoa butters from beans of various origins were pressed on a Carver laboratory press. The butters were filtered, carefully tempered and moulded into pieces approximating in size to chocolate centers. These were then coated with a standard chocolate as used in the manufacture of our chocolates and cooled in the normal way. The samples were then stored at a temperature fluctuating between 20° (68.0°) and 24° C (75.2° F) and a relative humidity of between 50 and 60%. These samples have now been stored for 36 months and in spite of relatively high and unfavorable storage temperature, none has yet bloomed.

At a later stage we shall mention that bloom can be prevented by warm storage tempering, the effect being particularly marked in plain chocolate. This fact also contradicts Becker's theory. Further, warm storage tempering should fail to prevent bloom in chocolates having fondant or liqueur centers because with these no fat can diffuse from the center into the coating and so alter the position of the metastable region. In fact warm storage does not fail with these centers. On the contrary, quite regardless of center composition, the tendency to bloom can be reduced merely by tempering and cooling the chocolate carefully. Chocolates with non-fatty centers show no bloom after 1 year at 20° C (68.0° F) even if the warm storage stage was omitted, always providing that the coating had been well conched, tempered without supercooling and cooled gently after enrobing.

As a result of our experience we believe that warm storage of chocolates causes the fat to sinter. The mixed crystals in the chocolate are only partly solid at these temperatures and triglyceride molecules can therefore diffuse to a certain extent, thus making the composition of the chocolate more uniform. As a result stresses are fairly well eliminated from the chocolate coating. If we were wrong in our assumptions, then the chocolates should bloom after a time because the fat had been brought into a metastable region and eventually the crystals should therefore decompose. This does not in fact happen. Fat bloom is almost entirely associated with rapid cooling, causing the fat phase to solidfy in an inhomogenous manner and we believe that this gives rise to pseudo-metastable regions. Vaeck in a recent paper (24) also disagrees with Becker's (15) ingenious theory of chocolate bloom since it does not tally with the facts. Vaeck notes quite correctly that the clear melting point of cocoa butter can rise slightly after several years' storage, as Fincke (27) showed years ago. This phenomenon is due to slow formation of crystals containing a high proportion of saturated glycerides. We showed in an earlier paper (28) that one can also produce these by seeding a melted cocoa butter and holding it at 32° C (89.6° F) for several hours with gentle stirring. Vaeck therefore quite definitely does not agree that bloom is caused by the formation of metastable regions. In his view Becker's (15) melting diagram shows that chocolate should bloom when the temperature drops below 15° C (59° F) which does not happen in practice, of course. Vaeck thinks that Becker's theory is wrong and that the arguments supporting it will not stand up to close examination.

There are, therefore, still a number of different theories regarding the cause of fat bloom and it would seem desirable that the Munich Institute should check theirs very thoroughly.

Experiments on suppressing fat bloom

A great deal of experimental work has been carried out in order to find methods of preventing bloom particularly on box chocolates and other small goods. In the main this work is based on adding small amounts of stabilizers to the chocolate. Much has been written, particularly in English, on the effects of sorbitol esters and glycerol monostearate (2, 3, 6, 7, 8, 9, 10, 11, 12, 13, 14 and 15). Most of these stabilizers are synthetic emulsifiers and their addition is legally prohibited in many countries. However, just as a matter of interest we included in our experiments a chocolate with 0.5% Tween 60 (polyoxyethylene sorbitan monostearate) and 0.5% Span 60 (sorbitan monostearate). According to Neville, Easton and Barton (3) these additions prevent fat bloom.

1. Preventing fat bloom by chemical means.

Under this heading one can include the addition of inhibitors, selective hardening and trans-esterification of cocoa butter glycerides and a combination of these. Inhibitors are substances which prevent or delay bloom. One can only use substances which are physiologically completely harmless. An inhibitor must have a bland odor and flavor so as not to affect the taste acceptance of the final product. Further there must be no side reactions which might affect the shelf life of the final product. Of course these considerations also apply to any modifications of the cocoa butter glycerides.

Additions of Span 60 and Tween 60 as suggested in

America cannot be used by firms interested in export and who, therefore, have to comply with regulations in many countries. Instead one cannot really object to the authorities' reluctance to permit additives which are produced by synthetic esterification or trans-esterification, particularly after the event which hit the Dutch margarine industry in 1960. We understand from reliable sources that the trouble there was caused by an emulsifier based on maleic acid stearyl ester. We therefore have been looking for years for substances which can safely be used in food and which are therefore permitted in many countries. In view of all these considerations it was an obvious step to test commercial hydrogenated and fractionated fats in the same series as the sorbitol derivatives (see Table 2). The latter after all have a structure which is very similar to that of glycerides consisting as they do of a higher alcohol (sorbitol) which is esterified with higher fatty acids.

Table 2 The substances which were tested as possible fat bloom inhibitors

Compound	Additives in percent calculated on the product.	Additives in percent calculated on the fat.
1. Glyceryl monostearate	0.5%	1.274%
2. Glyceryl monoarachidate	0.5%	1.274%
3. Span 60 (Sorbitan monostearate)	0.5%	1.274%
4. Tween 60 (Polyoxyethylene sorbitan monostearate)	0.5%	1.274%
5. Biscuitine fat (Mixture of arachis oil and hardened fat)	5.0%	12.74 %
6. Hardened arachis oil, Special 36 (hydrogenated)	5.0%	12.74 %
7. Butter fat (from cow butter)	4.0%	10.19 %
8. Criscax (butter fat mixed with vegetable fat)	5.0%	12.74 %
9. Hardened coconut oil 32 (hardened by fractionating)	5.0%	12.74 %
10. Refined coconut fat 24 (ordinary refined fat)	5.0%	12.74 %
11. Cocoa butter substitute CBSA/S-Hardened fat 38/40	5.0%	12.74 %
12. H. P. K. O. 36 (hardened by hydrogenating)	5.0%	12.74 %
13. Fractionated cocoa butter, iodine value 29	5.0%	12.74 %
14. Fractionated cocoa butter, iodine value 24	5.0%	12.74 %
15. Fractionated cocoa butter, iodine value 10	5.0%	12.74 %
16. Fat fraction No. III, iodine value 24	5.0%	12.74 %
17. Cocoa butter substitute GSP	5.0%	12.74 %
18. Cocoa butter substitute Cobudan	5.0%	12.74 %
19. Cocoa butter substitute HHH/37	5.0%	12.74 %
20. Nurupan, de-bittered soya bean flour	3.0%	7.64 %

All the compounds in Table 2 were tested in a standard coating of the following composition:

Cocoa mass containing about 56% cocoa butter	34.20%	Fat 19.15%
Sugar (sucrose)	45.50%	
Cocoa butter, added	20.10%	20.10%
Lecithin, containing 64% pure lecithin	0.18%	
Vanillin, (prepared from guaiacol)	0.02%	
Total	100.00%	39.25%

The additives, with the exception of Nurupan, were added in place of the corresponding amount of cocoa butter, the total fat content therefore was constant throughout. In order to test the effect of these additives, each of the coatings was used to enrobe the centers given in Table 3.

These centers were well pre-warmed before enrobing in order to prevent sudden solidification of the coating. The coatings were tempered and the enrobed pieces were cooled as described here. After cooling, some of the samples were subjected to various types of heat treatment. They were then stored under normal conditions, i. e. at a temperature varying between 18–22° C (64.4–71.6° F) and R. H. of 55 to 65%. We deliberately avoided the cycling, which has been devised in America (3), (12) as a method of accelerating the ageing process and consists of keeping chocolate for alternate 12 hour cycles at 31° C (78.8° F) and 20° C (68.0° F). Cycling has a tempering effect which we will consider later and leads to quite erroneous results. The results of our storage sets are given in Table 4.

Table 3. The centers which were enrobed in coatings containing additives to test affect of these additives

Type of Center	Detailed description
1. Fondant Creme	The fondant was cast in moulding starch in the usual way and was removed after 24 hours, then having 8.5% moisture.
2. Marzipan	A normal marzipan, containing about 10% moisture, was rolled to a layer 2 cm. in thickness. The centers were cut from this layer.
3. Nut Crunch	Sugar was melted until completely liquid and a small amount of blue smoke started to come off. Blanched grated almonds were then slowly added until the mix became fairly firm. The mix was then transferred to a warm table and processed to give the finished centers.
4. Nougat Montelimar	This is a nougat of French manufacture and does not contain any burned sugar.
5. Praline paste	This consists of finely ground almonds and hazel nuts processed with burned sugar.
6. Gianduja	Very similar to Praline, but the sugar is not burned.
7. Liqueur with Crust	The required amount of alcohol is added to a supersaturated sugar syrup at 70° C (158.0° F) and the mixture cast into moulding starch as for fondants. After 24 hours a firm crust of sugar has formed round the liquid and the centers are ready for enrobing.
8. Sandwich test piece	This consists of two nut crunch plates with an intermediate layer of marzipan as illustrated in Figure 1.

The results in Table 4 show that only 3 of the 19 additives helped to prevent fat bloom under our experimental conditions. These three were Biscuitine fat, hardened arachis fat special 36 and butter fat (rendered butter). Further practical experience, however, showed that these three substances can only prevent or delay fat bloom under very definite conditions. The following conditions will help to get the best performance from these additives:

a) A continuous fat phase must be established during

conching. A fat film without any gaps can then be formed on the enrobed pieces after the chocolate is above some critical lower limit, the magnitude of which depends on the internal surface of the non-fatty components in the system.

b) Conching must be carried out in such a manner as to enclose all non-fatty components in a well adhering layer of fat. In this way a continuous fat phase is formed in a multi-component system.
c) The amount of foreign fat depends on the cocoa butter content of the chocolate and the two should be present approximately in the proportion 1:10.
d) The centers should be prewarmed, without, however, attracting moisture to the surface by condensation or adsorption.
e) A chocolate must be used which has been tempered correctly, i. e. without supercooling.
f) After enrobing, the chocolates should be cooled as carefully as possible, using the smallest possible temperature gradients so as to avoid setting up any stresses in the coating.

The addition of butter fat, hardened arachis oil or Biscuitine, either singly or in combination gives a good gloss to the chocolate. With these three additives there is no danger of soapy off flavors being formed in the chocolate even if the centers are very moist. Butter fat is particularly useful since its addition to chocolate and coating is permitted in most countries. We, therefore, have an effective means of combating bloom in chocolates and other chocolate products.

Coconut and palm kernel fats, on the other hand, are of no use as inhibitors. If the centers contain moisture these fats soon produce a soapy flavor and in any case they accelerate rather than inhibit bloom as our experiments show.

In contrast to the results of American workers (3) we were unable to prevent or delay fat bloom by using a mixture of Span 60 and Tween 60 or by adding glyceryl monostearate or glyceryl monoarachidate singly. The same applies to fractionated fats which are mentioned in the same paper (3), c. f. our results with fractionated cocoa butter and fractionated palm kernel oil. Indeed there is a close correlation between iodine value and fat bloom formation. Fat bloom increases with decreasing iodine value.

In fact 5% added fractionated cocoa butter with an iodine value of 10 produced fat bloom in moulded 30 gm. bars after only 6 weeks at normal storage conditions (20° C = 68.0° F).

Unlike us, other authors have submitted their test samples to temperature cycles in order to accelerate ageing. Among these authors are Neville, Easton and Barton (3), Easton and Moler (12) and Hettich and Heiss (13). As we have already mentioned this treatment consists of alternate 12 hour cycles at 31° C (87.8° F) and 20° C (68.0° F) and is intended to speed up changes which might occur during storage. As Hettich and Heiss (13) quite rightly point out, this severe treatment does not really reproduce the behavior of chocolate under normal storage conditions at constant temperature. We find that, if one wants to check the effectiveness of additives against bloom there is really no substitute for 4–6 weeks' storage at temperatures fluctuating between 23° C (73.4° F) and 25° C (77.0° F). We will show later that warm storage for 12 hours at 31° C (87.8° F) as used in cycling, followed by storage under normal conditions will tend to make the chocolate permanently stable against fat bloom. This applies particularly if the chocolate contains a small amount of another glyceride in addition to cocoa butter and this effect is independent of the center composition. Concerning the effect of warm storage after manufacture, Cerbulis, Clay and Mack (14) got similar results independently and without knowing of our experiments. Neville Easton and Barton (3) and Easton and Moler (20) drew the wrong conclusion from their results when they believed that small amounts of Span 60 and Tween 60 gave permanent stability against fat bloom. The real cause for this stability was warm storage tempering.

Table 4

The effect of the additives given in Table 2 on the storage properties of chocolates.

Additive	Percent.	State of the samples after six months: Fondant	Marzipan	Nut Crunch	Nougat Montelimar	Praline Paste	Gianduja	Praline liqueur	Sandwich piece
1. Glyceryl monostearate	0.5	O. K.	O. K.	BL.	O. K.	BL.	O. K.	O. K.	BL.
2. Glyceryl monoarachidate	0.5	O. K.	Q. K.	BL.	O. K.	BL.	O. K.	O. K.	BL.
3. Span 60 Tween 60	0.5 0.5	O. K.	O. K.	BL.	O. K.	BL.	O. K.	O. K.	BL.
4. Biscuitine fat. 34/36	5.0	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.
5. Hardened Arachis spec. 36	5.0	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.
6. Butter fat	4.0	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.	O. K.
7. Criscax fat	5.0	O. K.	O. K.	O. K.	O. K.	BL.	O. K.	O. K.	BL.
8. Hardened coconut oil 32	5.0	S. O.	S. O.	BL.	O. K.	BL.	O. K.	O. K.	BL.
9. Refined coconut fat 24	5.0	S. O.	S. O.	BL.	O. K.	BL.	O. K.	O. K.	BL.
10. CBSA/S Hardened fat 38/40	5.0	O. K.	O. K.	BL.	O. K.	BL.	O. K.	O. K.	BL.
11. H. P. K. O. 36	5.0	S. O.	S. O.	BL.	O. K.	BL.	O. K.	O. K.	BL.
12. Fractionated cocoa butter I. value 29	5.0	O. K.	O. K.	BL.	O. K.	BL.	O. K.	O. K.	BL.
13. Fractionated cocoa butter I. value 24	5.0	S. BL.	S. BL.	P. BL.	S. BL.	P. BL.	S. BL.	S. BL.	P. BL.
14. Fractionated cocoa butter I. value 10	5.0	P. BL.	P. BL.	P. BL.	P. BL.	P. BL.	P. BL.	P. BL.	P. BL.
15. Fat fraction No. III Iodine value 24	5.0	P. BL.	P. BL.	P. BL.	P. BL.	P. BL.	P. BL.	P. BL.	P. BL.
16. G. S. P. cocoa butter subst.	5.0	O. K.	O. K.	BL.	O. K.	BL.	S. BL.	O. K.	BL.
17. Cobudan, cocoa butter subst.	5.0	O. K.	O. K.	BL.	O. K.	BL.	O. K.	O. K.	P. BL.
18. HHH/37 cocoa butter subst.	5.0	O. K.	O. K.	BL.	O. K.	BL.	BL.	O. K.	P. BL.
19. Nurupan, soya bean flour	3.0	O. K.	O. K.	BL.	O. K.	BL.	O. K.	O. K.	BL.

Legend:
1. O. K. = Samples satisfactory in flavor and odor.
2. BL. = Fat bloom.
3. SO. = Samples taste soapy and unpleasant.
4. S. BL. = Slight fat bloom.
5. P. BL. = Pronounced fat bloom.

Nurupan has been mentioned (22), (23) in the trade papers as a fat bloom inhibitor. For the sake of completeness, therefore, we included this in our tests. Our results showed no definite indication that Nurupan inhibited bloom. We therefore feel that it would be wrong to consider this material as a bloom inhibitor or to sell it as such.

2. Combating bloom by physical means

Strictly speaking temperature adaptation of the centers, tempering correctly and cooling the enrobed pieces are all physical methods which help to combat bloom. However we have already discussed these in detail and will not do so again. We will deal below with physical methods in a narrower sense, considering only specific methods of treatment with a definite object.

A. Tempering chocolates in a warm air bath at 32° C (89.6° F)

Keil and Hettich have shown (11) that after 7 weeks' storage at 32° C (89.6° F) cocoa butter assumes a typical X-ray diffraction pattern which is not altered by further warm storage. The authors have ascribed this pattern to the stable β polymorphic form which, according to them, melts at 35.5° C (95.9° F) to 36.0° C (96.8° F). We based ourselves on Keil and Hettich's work, when we investigated methods (21) of pretreatment designed to give cocoa butter melting points which were as constant as possible. We left the fat with continual stirring at 32° C (89.6° F) until a crystal slurry was formed. With further continual stirring the temperature was then raised very slowly to 34.5° C (94.1° F). It is interesting to note that the fat was always turbid at this temperature. This shows that crystals had been formed with melting points which were even higher than 34.5° C (94.1° F). In our paper in the International Chocolate Review, No. 11, 1954, we showed that these melted fats always produced solid cocoa butters which had melting points that agreed with those of Keil and Hettich and were appreciably higher than those of samples made by the method suggested by the technical committee of the International Chocolate Office in Paris 1955 (Circular VII/1, Berne, 14th June, 1955). The very fact that one can increase the melting point of cocoa butter by heat treatment seemed to us to be eminently important when one is trying to find ways of making chocolate keep better in the summer. Cocoa butter in chocolate is present as a continous phase, at least when the chocolate has been well conched and tempered. We therefore decided to investigate, if heat treatment of the finished goods, and in particular, of coated chocolates, leads to any increase in temperature resistance. Furthermore, we hoped that such treatment would change the cocoa butter into the β-form which is the most stable polymorphic form. In order to find the optimum temperatures and the minimum time for this treatment, we carried out the following experiments on our sandwich test pieces.

a) To find the best air temperature

Sandwich test pieces were used since they are particularly prone to fat bloom. Samples were stored for 14 hours in thermostatically controlled incubators at 28° C (82.4° F), 29° C (84.2° F), 30° C (86.0° F), 31° C (87.8° F), 32° C (89.6° F), 33° C (91.4° F), 34° C (93.2° F) and 35° C (95.0° F). The samples were then cooled for 2 hours at 18–20° C (64.4–68.0° F) and the chocolate was then inspected. Even the first experiment showed that the coating became duller and less attractive with decreasing temperature below 31° C (87.8° F). On the other hand chocolate begins to flow above about 32° C (89.6° F), (the exact temperature depends on the fat content of the chocolate) and "feet" are formed at the base of the piece. Only a very narrow temperature range therefore is available for this warm air treatment.

b) To find the minimum time required

As a result of the previous experiments we chose 32° C (89.6° F) as the optimum temperature. Again using the sandwich pieces we started at a holding time of 5 minutes. Each subsequent run lasted twice as long as the previous one, the last one being the 8th with a holding time of 640 minutes. The chocolates were then stored at 20–22° C (68.0–71.6° F) and were inspected at intervals of about four weeks. 80 minutes warm storage at 32° C (89.6° F) was found sufficient to give one year's resistance against fat bloom.

c) Chocolate storage experiments on a semi-production scale

Storage tests on sandwich pieces continued to give good results both appearance and flavor wise. We therefore treated our whole assortment of 35 different chocolates by holding them in air at 32° C (89.6° F) for 120 minutes. These samples and untreated standards were again stored at 20–22° C (68.0–71.6° F). Though the centers differed widely, none of the treated chocolates bloomed in four years. These experiments also showed that in storage of tempered chocolates, the gloss was improved by the addition of about 4% of another fat or similar substance, the amount being calculated on the cocoa butter.

We thought that this improved resistance to bloom after warm storage occurred because the fat was changed to the stable β-form. However, Becker (15) carried out some X-ray tests on ordinary and warm-stored coatings and found that warm storage increased the proportions of β-crystals only slightly and not enough to make any difference in the stability. He also determined the iodine values of the fat from the pure chocolate, the uncoated centers and the chocolate peeled from warm stored and non-warm stored chocolates. The results in Table 5 show that appreciable amounts of fat diffuse into the chocolate coating during warm storage.

(*Continued on page 38*)

Table 5

Some iodine values determined by Becker (15)

Fat extracted from:	Iodine value
1. Pure chocolate	38.7
2. Uncoated fatty centers	81.7
3. Coating peeled off non-warm stored chocolates which had not been warm stored	39.1
4. Coating peeled off warm stored chocolates	44.2

Becker concludes from these results that during the warm treatment, sufficient fat penetrates into the chocolate to shift the metastable region which in his opinion is necessary for fat bloom. This seems very reasonable and if it is right, the treatment should have no effect on chocolates with non-fatty centers. However, our experiments show that warm storage works equally well with fondant and liqueur centers. We therefore cannot agree entirely with Becker's conclusions. We have already mentioned that Becker's theory is based on the assumption that in the solid state the components of cocoa butter are only partly soluble in one another. Fat bloom according to Becker, therefore, is closely linked with glyceride fractionation, i. e. with the metastable regions. When cocoa butter is cooled, mixed crystals are formed in similar ways as those formed in alloys. These mixed crystals, of course, are different from the individual components of the system.

Affect of warm storage

In cocoa butter, particularly if it is cooled quickly, these mixed crystals tend to have a center which is enriched with higher melting glycerides while the outside layers contain a high proportion of the lower melting glycerides. This is because there is not enough time for the long chain fat molecules to diffuse through the mix as it is setting and to establish a uniform concentration. As a result internal tensions are set up, especially if the chocolate is cooled quickly. We believe that, in analogy to alloys, warm storage allows these tensions to be released. This may explain the fact that warm storage works even when the centers contain no fat which might diffuse into the coating. We, therefore, believe that warm storage prevents fat bloom because it allows endogenous and exogenous tensions to be equilibrated, thus producing a homogenous and therefore stable chocolate.

Unfortunately 120 minutes storage at 32° C (89.6° F) had an adverse effect on both the organoleptic and visual acceptability of some of the centers. For some centers the warm air treatment has to be kept very short indeed if adverse effects are to be avoided, too short in fact to do any good. In an attempt to find a short term treatment which would give satisfactory results, we tried high frequency heating.

B. Tempering chocolates by high frequency heating

These experiments were carried out at the laboratories of Messrs. Brown, Boveri & Co., Baden, Switzerland. Again we used centers enrobed in standard coating containing some butter fat, the selection being that given in Table 3. We were unable to obtain any clear information from measuring the di-electric constants of centers and enrobed chocolates and therefore we relied entirely on practical experiments. High frequency heating can be carried out continuously and it is therefore important that all the goods should take up heat at a fairly uniform rate. Unfortunately chocolates with moist centers take up much more energy than dry ones and therefore heat up much more in a given time. This may cause the chocolate to flow and therefore the goods to spoil.

Table 6

The results of tempering by high frequency heating, carried out at Brown, Boveri & Co., Baden, Switzerland. (RF Tension constant at 4.5 kV, electrode gap d = 26 mm).

Type of center	ε coated	ε • tg δ x 10-2 coated	ε • tg δ x 10-2 uncoated	Field strength kV/cm	Time of heating in sec.	Uniformity of heating the samples
Sandwich test piece	4,2	42	55	0,73	25	Uniform, good
Praline paste burnt sugar	3,8	15	15	0,95	57	Uneven owing to a nut on surface
Nut crunch	5,0	70	70	0,65	25	Uniform, good
Gianduja paste sugar not burnt	3,0	7	8	0,90	85	Uniform, good
Honey cream, semi-liquid	4,3	28	356	0,72	45	Uniform, good
Candied pineapple	8,0	54	126	0,50	20	Uneven, warmer at base
Marzipan	7,0	42	83	0,52	23	Uniform, good
Nougat Montelimar	3,5	55	55	0,84	17	Uniform, good
Cherry Brandy butter cream	6,0	50	112	0,52	15	Uneven, warmer at base
Soft Nougat	4,2	34	36	0,78	10	Forms bubbles
Maraschino butter cream	3,8	15	22	0,69	50	Uniform, good
Fondant, semi-liquid	8,3	50	96	0,37	6	Uneven, warmer below

The results in Table 6 show that the times required for high frequency heating vary very widely. This complicates continuous working very much.

The samples heated in this way were then stored at 20–22° C (68–71.6° F), for more than 15 months, together with untreated standards. We found that bloom was well suppressed where the chocolate had heated up uniformly. However, in some cases the heating times required varied very widely both between different types of center and between different samples of the same center. This was due to variations in moisture content. For this reason, and also because a commercial plant is very expensive, we abandoned this line of research and tried to find a method which would specifically heat the coating only.

C. Tempering of chocolates by infra-red radiation.

Heating after enrobing both by warm air and by high frequency treatment produced resistance against fat bloom and we were therefore sure that we were on the right lines. A number of experiments had also shown that permanent stability against bloom is best obtained by first heating the chocolate very slowly until the fat phase begins to sinter and then cooling very gently. In view of this and in order to avoid the disadvantages of the other methods of heating, we decided to examine the possibility of using infra-red

radiation as a source of heat. The first experiments were very promising and showed that infra-red heats chocolate very quickly, the brown colour of chocolate being particularly suitable. In order to get the desired results, however, the chocolates must be heated from all sides as well as being heated quickly. Special heating tunnels fitted with reflectors inside are therefore necessary. They are shown diagramatically in Figure 7. The tubular infra-red heaters also have to be specially arranged in order to obtain uniform irradiation from all sides.

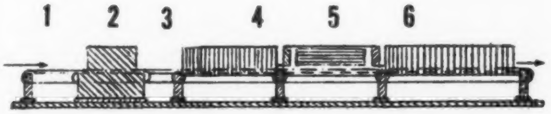


Figure 7. Diagram of a production line used for making bloom resistant chocolates, showing the necessary primary and secondary coolers and the infra-red tempering zone in between.

1 = Center feeding.
2 = Enrober.
3 = Primary cooling by heat radiation.
4 = Infrared tempering zone.
5 = Secondary cooling by heat radiation.
6 = Delivery.

Infra-red heat is applied for a short period only and can therefore be used on a continuous basis. This method of fat stabilizing, therefore, is particularly suitable in combination with gentle cooling by heat radiation. This is indicated in Figure 7. Infra-red tempering acts for a short time and then virtually only on the coating so that even very sensitive centers are not changed in taste or appearance. Samples were stored for 2 years at temperatures varying between 20 and 22° C (68.0 and 71.6° F). They showed that infra-red tempering stabilizes the fat phase completely so that no fat crystals can grow on the surface. After infra-red treatment however the goods must be cooled very carefully and cooling by heat radiation is therefore particularly useful. Owing to lack of space we have not yet been able to put an infra-red heating tunnel into our production line. However, for some years we have successfully used cooling by heat radiation, i. e. without blowing cold air, as described by Morgan (18) and Mills (19). Our engineer, Mr. R. Raths, has designed a particularly well adapted cooling tunnel, based on this experience. This cooler works entirely on the principle of heat absorption and its particular features are very low energy consumption, the application of the coolant, and excellent accessibility throughout its length. The installation, therefore, is very readily cleaned, an important point when dealing with food machinery. Furthermore, if required, this cooler can be run at very low temperatures without forming condensation on the cooling plates inside. Such condensation would, of course, reduce the performance. It will be difficult to make any fundamental improvement on this cooler.

Several progressive firms have shown that careful cooling of chocolate by heat radiation gives a definite increase in shelf life. Others, however, even some with scientific knowledge, are very sceptical. Their scepticism induced us to try and clear up some of the fundamental facts by further laboratory work. We started with the basic assumption that cooling by convection requires air or a gas as a carrier. This method of cooling, therefore, should fail to work in a vacuum. Cooling by heat radiation on the other hand should also work in vacuo. We therefore got Messrs. Buss A. G. Pratteln/BL to construct the apparatus which is illustrated in Figure 8. The sketch shows that it consists of two jacketed autoclaves which can be evacuated and which are very well insulated to protect them from outside influences. The inside of one autoclave was polished to a mirror finish in order to obtain maximum reflection of heat rays, while the inside of the other was coated with a dull black color for maximum heat absorption.

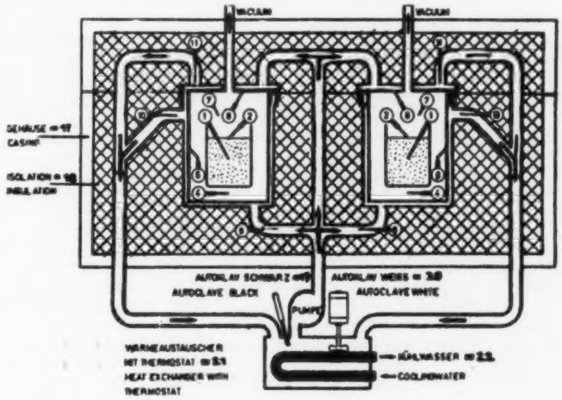


Figure 8. Diagram of the apparatus which we are using for our studies on cooling melted cocoa butter and chocolate by heat radiation.

Legend:

1 = Spot for measuring the center temperature of the samples.
2 = Spot for measuring the surface temperature of the samples.
4 = Spot for measuring air temperature between sample and base of autoclave.
6 = Spot for measuring temperature at inner jacket of autoclave.
7 = Spot for measuring temperature of air between sample and lid of autoclave.
8 = Spot for measuring temperature at inside of autoclave lid.
9 = Spot for measuring temperature of inlet water.
10 = Spot for measuring temperature of water coming from autoclave jacket.
11 = Spot for measuring water coming from lid of autoclave vessel.

Each vessel is fitted with eleven spots for measuring the temperature, two of these being specially constructed to give the temperature at the surface and the center of the sample throughout the experiment. Since the autoclaves are jacketed all round they can be heated or cooled as required for the experiment. One can therefore examine the effects of varying the temperature gradient between sample and autoclave surface.

We have carried out a number of cooling experiments on melted cocoa butters and tempered chocolates. The results show quite clearly that one can successfully cool by heat radiation, i. e. by absorbing the liberated energy on cooled, dull black metal surfaces. In an autoclave with shiny, heat reflecting surfaces, the center temperature of the sample, and even more its surface temperature, both fall more slowly than they do in an autoclave with dull, black, heat absorbing surfaces. This is illustrated very well by curves S/1 and W/1 as well as S/2 and W/2 in Figure 9. (*Continued on page 40*)

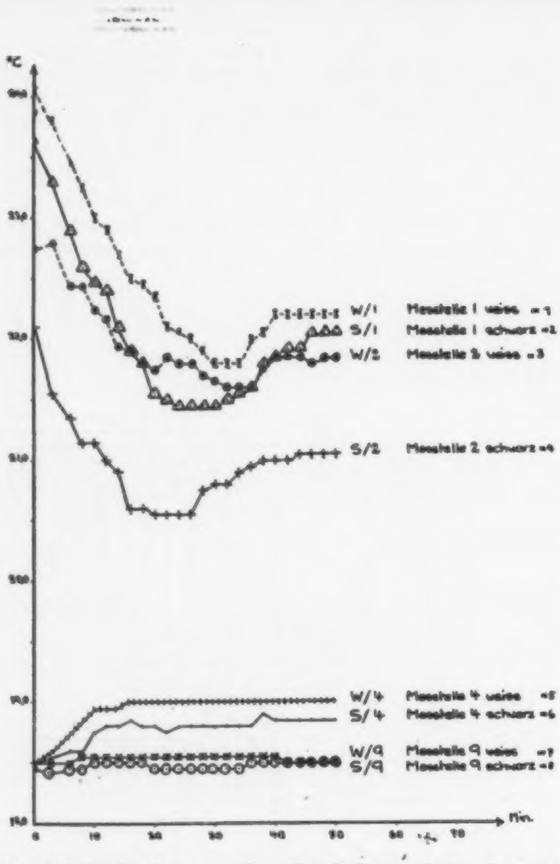


Figure 9. Graphs showing cooling of melted cocoa butters in vacuo, the radiated heat being absorbed on black and mirrored surfaces at 18.5° C (65.3° F).

W/1 measuring spot 1. White
S /1 measuring spot 1. Black
W/2 measuring spot 2. White
S /2 measuring spot 2. Black
W/4 measuring spot 4. White
S /4 measuring spot 4. Black
W/9 measuring spot 9. White
S /9 measuring spot 9. Black

Legend:

W = Mirrored reflecting autoclave.
S = Dull, black, absorbing autoclave.
1 = Spot measuring center temperature of samples.
2 = Spot measuring surface temperature of samples.
4 = Spot measuring temperature of air between sample and base of autoclave.
9 = Spot measuring temperature of inlet water for jackets in body and lid of autoclaves.

The temperature changes at spots S/4 and W/4 are compatible with those of the samples, measured at S/1/2 and W/1/2. The dull, black autoclave absorbs heat better and the temperature between sample and autoclave base rises less than the comparable temperature in the shiny autoclave.

Curves S/9 and W/9 show the temperature variations of the incoming cooling water and illustrate the efficiency of the thermostat.

There was always a marked difference in the structure of solidified samples taken from the two autoclaves. Those cooled gently by radiation always had a visibly finer, denser and more homogenous crystal structure.

We are still in the middle of these experiments and will report the results in detail at a later date.

In conclusion I would like to thank the directors of Lindt & Spruengli and particularly Mr. J. Jegher for making this work possible and for the understanding with which he supports the work of our laboratory.

Summary

By way of introduction, it is suggested that it is in the interest of the whole of the Chocolate Industry to find an effective method of preventing fat bloom. Present published work on fat bloom and its prevention is then discussed.

The second section deals with the possible causes of bloom. It was found to be very important to adapt the temperature of centers and moulds to that of the tempered chocolate. If the ambient conditions are wrong, however, there is the danger that the centers take up surface moisture during this stage. Special sandwich test centers were used to demonstrate the effect of temperature and moisture on fat bloom formation. These centers were made up of two thin plates of nut crunch with marzipan in between. Cocoa butter polymorphism is also discussed in detail, since it can cause bloom in chocolates which have been badly tempered or cooled too rapidly. Detailed directions in line with the latest published information are given on tempering of chocolate and cooling the enrobed chocolates.

Becker's (15) bloom theory is examined critically, using examples. This theory involves the existence of a metastable region and contains some internal contradictions. Our results are incompatible with Becker's theory, and we believe that pseudo-metastable regions are formed in chocolates which are cooled too quickly.

As a result of many experiments it is shown that one can prevent bloom in enrobed chocolate goods by chemical means and by purely physical ones. A table shows the substances which were examined as possible bloom inhibitors. These were added to a standard coating of which the formula is given. Another table shows the centers which were used for these tests, and yet another the effectiveness of each additive with each center. Of 19 additives which were tried, only butter fat, hardened arachis oil, and Biscuitine fat delayed and partly even prevented bloom, and even these did so only under very definite conditions. Additions of Span 60 and Tween 60 or of glyceryl monostearate used alone were all ineffective. This is in contrast with the findings of some American (3) workers. Fractionated cocoa butters also failed; in fact they accelerated bloom. It was found that bloom formation is closely correlated to the iodine value, bloom increasing with decreasing iodine value.

American workers (3), (12) have used cycling to speed up bloom formation and it is here shown that this treatment does in fact give permanent protection against bloom, particularly if the chocolate contains small amounts of foreign glycerides. The results of Neville, Easton and Barton (3) and Easton and Moler (20) are, therefore, questioned. These authors thought they were preventing bloom by small additions of glyceryl monostearate or of Span 60 and Tween 60, whereas we believe that their cycling tempered the

chocolate and therefore made it bloom-resistant. Nurupan additions also failed, in contrast to references in the literature (22), (23).

Warm storage tempering of the finished products was found to be a most effective means of suppressing bloom. This process, however, must be carried out quickly so as to avoid visual or organoleptic changes in the centers. Warm storage in air at 32° C (89.6° F), for instance, had an adverse effect on many centers, because poor heat transmission by this method entails prolonged treatment. Warming the finished goods by high frequency heating stabilizes the fat phase completely and prevents bloom. However, the time required for heating depends on the center moisture and varies very widely between different centers as shown in a table. This makes it very difficult to use this method on a continuous basis.

Infra-red radiation was, therefore, tested as an alternative source of energy. The results were very successful. By this method one can direct the heat specifically to the coating and warm this up very quickly, without any adverse effect on the centers. The heating times are short enough for continuous working and this method is particularly suitable for combination with cooling by heat radiation. A sketch is given to illustrate the general layout. This combination gives the most favorable conditions for stabilizing the fat phase in a coating.

We do not share Becker's (15) view that the beneficial effect of warm storage tempering is caused purely by transfer of center fat into the coating because the method works equally well with nonfatty centers. We believe instead that warm storage allows endogenous and exogenous tensions in the coating to disperse and transform the continuous fat phase of the chocolate into a structure which is homogenous, has no tensions and is therefore stable. The process is analogous to the tempering of alloys.

As a result of considerable practical experience we conclude that gentle and careful cooling is a very important factor for preventing bloom. We therefore allude briefly to a piece of apparatus which was specially constructed in order to study cooling by heat radiation. This apparatus is illustrated and experiments with it are still continuing. They will be published at a later date.

Literature

(1) Clayton, W., Back, S., Johnson, R. J. and Morse, J. F.: **Physico-Chemical Investigation Incidental to the Study of Chocolate Fat Bloom, Part. I.**
Journal of the Society of Chemical Industry, Vol. L. V. I. p. 196 T—199 T, June (1937).

(2) Lutton, E. S.: **Review of Polymorphism of Saturated Even Glycerides.**
The Journal of the American Oil Chemists Society, p. 276—281, July (1950).

(3) Neville, H. A., Easton, N. R. and Barton, L. R.: **The Problem of Chocolate Bloom. Food Technology,** Vol. IV, p. 411—439, No. 11, November (1950).

(4) Bailey, A. E.: **Melting and Solidification of fats,** New York, p. 23 (1950).

(5) Vaeck, S. V.: **Die Polymorphie einiger Naturfette.**
R. I. C. No. 4, p. 100 ff, April (1951).
I. Thermische und mikroskopische Studien uber die Kakaobutter.
II. Kalorimetrische Studien an Kakaobutter. R. I. C. No. 12, p. 350 ff, December (1951).
III. Dilatometrische Studien an Kakaobutter. R. I. C. No. 11, p. 323 ff, November (1952).

(6) Alikonis, J. J. and Farrel, K. T.: **Improvement of Cocoa-Type coating for use in army rations.**
Confectioners Journal, p. 40—41, August (1951).

(7) Moculeski, C. F.: **Improving candy with edible monoglycerides. International Confectioner,** p. 12—13, October (1952).

(8) Berman, M.: **Off-seasons testing of summer candies. Confectioners Journal,** p. 8—10, November (1952).

(9) Sachsse, M. und Rosenstein, J.: **Ueber den Fettreif der Schokolade.**
I. Fette und Seifen, Vol. 55, No. 1, p. 26—29 (1953).
II. Fette und Seifen, Vol. 55, No. 2, p. 122—124 (1953).
III. Fette und Seifen, Vol. 55, No. 3, p. 196—198 (1953).

(10) Kleinert, J.: **Schokoladenerzeugnisse und Fettreifverhutung, Zucker- und Sussawarenwirtschaft,** Vol. 6, No. 7, p. 251—253 and No. 8, p. 332, April (1953).

(11) Keil, C. und Hettich, A.: **Die Phasenzustande des Kakaofettes. Revue Internationale de la Chocolaterie.** (R. I. C.) Vol. VIII, No. 10, p. 265—270, October (1953).

(12) Easton, N. R. and Moler, E. S.: **Die chemische Zusammensetzung von Kakaobutterreif. Zucker- und Susswarenwirtschaft,** No. 7, p. 261—262, April (1954).
Composition of Cacao Butter Bloom.

(13) Hettich, A. und Heiss, R.: **Untersuchungen uber technologische Einflusse auf die Fettreifneigung von Couverturen.** Fette, Seifen, Anstrichmittel, Vol. 57, No. 11, p. 954—963, (1955).

(14) Cerbulis, J., Clay, C. and Mack, C. H.: **The Composition of Bloom Fat in Chocolate. The Journal of the American Oil Chemists Society,** Vol. XXXIV, No. 11, p. 533—537, November (1957).**The Composition of Bloom Fat in Chocolate. Confectionery Production,** Vol. 24, No. 3, p. 221—226, March (1958).

(15) Becker, K.: **Ueber die Fettreifbildung bei Schokoladen und Pralinen I.**
Fette, Seifen, Anstrichmittel, Vol. 59, p. 636—643, No. 8 (1957).
Die Ursachen der Fettreifbildung bei Schokoladen und Pralinen I. Revue Internationale de la Chocolaterie, Vol. VIII, No. 6, p. 246—249, June (1958).

(16) Duck, W.: **A study of viscosity increase due to solid fat formation in tempering chocolate coatings.**
The Manufacturing Confectioner, p. 9—12, July (1958).
Eine viskosimetrische Laboratoriumsmethode zur Ermittlung des in temperierter Couverture vorhandenen Anteils an festem Fett. Fette, Seifen, Anstrichmittel, Die Ernahrung, Vol. 62, No. 8, p. 705—709, August (1960).

(17) Hettich, A.: **Neuere Kenntnisse uber das Temperieren von Schokolade.**
Gordian, LI 1230—1232, Vol. 51, p. 10 ff, 25. 2. (1955)
p. 13 ff, 10. 3. (1955).
p. 12 ff, 25. 3. (1955).

(18) Morgan, E. H.: **Surprising Results Coming up with Radiant Cooling. Food Engineering,** p. 62, 63, 155, June (1955).
Crystallisation Controlled Through Radiant Cooling. Confectioners Journal, January (1956).
Improved Candy Making Through Radiant Cooling. Tenth Annual Production Conference.
Pennsylvania Manufacturing Confectioners Association, April 27th. (1956).

(19) Mills, C. A.: **The mechanics of radiant heat transfer. The Manufacturing Confectioner,** No. 1, p. 21—24, January (1958).

(20) Easton, N. R. and Moler, E. S.: **The Use of Modifiers to Retard Fat Bloom. The Institute of Research,** Lehigh-University, Bethlehem, (Pa) U. S. A.

(21) Kleinert, J.: **Vergleichende Schmelpunktbestimmungen an Kakaobutter und Speisefetten. Revue Internationale de la Chocolaterie** (R. I. C.), No. 11, p. 329—341, November (1954).

(22) F. P.: **Nurupan im Dienste der Schokolade- und Zuckerwaren-Industrie.**
Der Mitarbeiter.
Gordian, L. V., Vol. 1330, p. 32 f., 30. April (1956).

(23) F. P.: **Einsatzmoglichkeiten und Erfolge mit Nurupan.** R. I. C., Vol. XI, Nr. 6, p. 293—294, June (1956).

(24) Vaeck, S. V.: **Cacaobutter and fat bloom.**
The Manufacturing Confectioner, p. 35 ff, June (1960).
Ueber Kakaobutter und den Fettreif von Kakaoerzeugnissen. Fette, Seifen, Anstrichmittel, Vol. 62, No. 8, p. 709—722, August (1960).

(25) Duck, W.: **Eine viskosimetrische Laboratoriumsmethode zur Ermittlung des in temperierter Couverture vorhandenen Anteils an festem Fett.**
Fette, Seifen, Anstrichmittel, Vol. 67, No. 8, p. 705—709, August (1960).

(26) Gorling, P., Becker, K. und Heiss, R.: **Vergleichende Untersuchungen uber die Kuhlung von Schokolade durch Strahlung und Konvektion.**
Gordian, Nr. 1421, p. 14 (852), 10. February (1960).

(27) Fincke, H.: **Kleine Beitrage zur Kenntnis des Gefuges der Kakaobutter bei verschiedenen Warmegraden.**
Zeitschrift Untersuchung der Lebensmittel, Vol. **80,** p. 12—41, July/August (1940).

(28) Kleinert, J.: **Vergleichende Schmelzpunktbestimmungen an Kakaobutter und Speisefetten.**
Zucker- und Susswarenwirtschaft, Vol. 7, Nr. 18, p. 772—780, 20. September (1954).

HOW to radiantly cool chocolate products

By applying the principles of quantum mechanics, the candy industry can improve production operations

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Applications of developments in the field of theoretical physics are today bringing revolutionary changes in numerous phases of industrial processing operations. Transistor use in calculating, control, communication, and many other kinds of equipment, nuclear energy for power development, direct conversion of thermal energy into electrical power, liberation of nuclear energy,—these are but a few of the useful end results in industrial processing resulting from the recent developments in theoretical physics.

Of greatest importance for the chocolate industry have been developments in the fields of Liquid and Solid State Physics and the physical and energy changes involved in "change-of-state" solidifying processes. The chocolate industry,—and hard candy also—, has up to now failed to apply this newer knowledge to its "change-of-state" energy transfer problems. More specifically, there has not been appreciation of the basic difference between *latent* and *sensible* heat, nor of the radiant character of energy transfer as clarified by the newer knowledge of quantum mechanics.

For the past three decades air conditioning engineers have cooled chocolate products by picking up their excess heat on moving streams of cooled air. Today we realize that such cooling methods are faulty and inefficient; that cooling materials emit most of their heat in radiant form—especially with *latent* heat of "change-of-state"; and that the most efficient cooling methods or systems are those engineered to receive and remove this radiant heat directly. The purpose of this communication is to express as clearly as possible the radiant heat transfer principles involved and present cooling system engineering which allows optimal functioning of these theoretical principles.

According to the newer knowledge of Liquid and Solid State Physics (1), atoms are small universes within themselves, with their highly energized component neutrons, protons and electrons held in their relative positions by the atom's electromagnetic and gravitational forces. The protons, neutrons and inner-shell electrons constitute the stable atomic core, while much greater lability and reactivity reside in the highly active outer-shell valence electrons (2).

The whole atomic universe tends to maintain itself in energy equilibrium with its surroundings, emitting and receiving radiant energy. The nuclear core and outer-shell electrons emit radiations in the shorter infrared wavelengths (1 to 10 microns), while the vibration or rotation of the atom as a whole is associated with the emission of radiations far out at the longest infrared wavelengths (100 to 400 microns). These latter are the so-called "rest" or "residual" rays characteristic also of all *latent heat* emission in "change-of-state".

Disturbances within the atomic nucleus (nuclear fusion of fission reactions) are associated with radiant emissions in the visible and ultraviolet ranges of wavelengths. With these we are not concerned in commercial cooling operations.

Sensible cooling of organic substances without "change-of-state" involves mainly the dissipation of

the shorter wavelength infrared radiations emitted by the atomic components. These short-wavelength radiations have little penetrating power and must be re-radiated many times in their passage outward for final emission from the material's surface layers. This re-radiation we commonly call "conduction". *Sensible* cooling also involves, in lesser part, the emission of ultra-long wavelength radiations arising from vibration of the whole particle. These can exit directly, since most organic materials possess a high degree of transparency to them.

What is latent heat

Latent heat emission consists *only* of the ultra-long wavelength radiations which can in large part exit directly from the solidifying material. These long-wavelength radiations are reflected back from all metal surfaces unless carbon-blacked, and they slowly produce deep warming of all non-metallic substances exposed to their effects.

In the hardening of chocolate (moulds or coatings) these ultra-long wavelength radiations constitute ¾ to ⅘ of the total heat removal load, hence the basic importance of proper engineering for their absorption and removal. These radiations form an important part of the heat emitted from any material undergoing a hardening process (hard candies, chocolate, fudge, taffy, caramel, plastics).

As gases undergo sensible cooling, they eventually reach the stage where the independently vibrating gas particles assume a direct, though loose, outer-shell-electron relationship with their immediate neighbors on all sides,—and the "change-of-state" from gas to liquid has been accomplished, with the emission of the *latent heat* of condensation radiated off at ultra-long infrared wavelengths. The attraction or association among liquid particles extends only to the immediate neighbor and involves the fixation of only a portion of the outer-shell electrons. As liquids convert to the crystalline lattice of solids, however, fixation of the outer-shell electrons progresses much further and the association extends out to whole families of particles in repetitive patterns throughout the solid's crystalline lattice structure. It is this increasing closeness of particle associations and limitation of outer-shell electron freedom of motion that gives rise to *latent heat* radiant emisions at the penetrating ultra-long infrared wavelengths.

Affect of latent heat

It was in the radiant cooling of chocolate coatings and cookie sandwich or sugar wafer fillings that the mysterious behavior of *latent heat* first made its appearance in our work. In the hardening of chocolate coatings, for instance, the "change-of-state" *latent heat* liberated as the coating's fatty fractions harden is more than four times the total *sensible heat* emitted over the required 20°F. cooling range,—yet provisions need be set up only for radiant transfer of the *sensible heat* between cooling surface and carbon blacked cold plate in accordance with the familiar Stefan-Boltzmann formula. The full increment of *latent heat* also gets across from coating to cold plate and shows up in the loading on the cold plate refrigerating system, obviously without regard to the Stefan-Boltzmann surface emission formula. Only by the concept of *radiation-in-depth* can such behavior be explained.

Further proof of *radiation-in-depth* was obtained in the radiant cooling of sugar wafer fillings in still air. Such fillings usually contain liquid fats which must be crystallized at or near 78° to bring about the desired hardening and rigidity. In one series of tests, the filling batter was spread at 90° onto a wafer sheet at 120°F. and another wafer sheet at 120° laid on top of the spread filling. Exposure to blackened plates maintained at 33°F. in still air for 4 minutes resulted in satisfactory hardening of the filling layer at a temperature of 77°F. while the encasing wafer sheets were still at 81°F. Similar results were obtained with 3 wafer sheets and 2 layers of filling. Since the filling batter contained essentially no free water to cause evaporative cooling, it is obvious that its large increment of *latent heat* and at least part of its *sensible heat* must have been emitted in radiant form outward through the warmer encasing wafer sheets.

Since engineering books and practices in the field of heat transfer offered no explanation (or even recognition) of such radiation-in-depth, it became necessary to seek needed enlightenment in the principles of quantum mechanics. Practical applications of these principles as enunciated above have led to very great advances in the radiant cooling of organic products.

First radiant cooling tunnel

The first radiant cooling tunnel, in successful operation since early 1956, had lateral cold plates and a curved reflector for cooling from above, and a flat plate below for bottom cooling through a polyethylene-type belt on a wire-mesh carrier. No effort was made to prevent moisture condensation on the plate coils, which were operated just above icing temperatures. Drip troughs were provided to carry away the small amount of condensate. No purposeful air movement was provided in the tunnel, but a small amount of natural convection did occur—upward from the warm product and downward along the upper vertically positioned cold plates. The total exposed plate coil surface was slightly greater than the belt surface area, both above and below, and all other inside tunnel surfaces were of infrared-reflective aluminum sheet.

This first tunnel design gave faster hardening of chocolate coatings than had been possible in the older air-cooled tunnels, with a better through-and-through-crystal structure, higher surface gloss and longer shelf life. Attempts to further speed up cooling by dropping circulating brine temperatures below 30°F. resulted in glaze-ice formation on the plate coils and a sharp reduction in cooling potential because of infrared reflection from the iced surfaces.

The second tunnel design differed from the first in a better spacing of upper plate coils above the product belt, the use of angulated instead of curved aluminum reflectors, and drip troughs attached to the lower plate edges. This permitted the use of shallower plate coil assemblies above the product belt and a more compact tunnel. Its main advantage, however,

lay in the greater adaptability for conversion of old air-cooled tunnels to radiant cooling within the restricted space limitations usually prevailing.

This second design also made use of an expanded-metal glider bed to facilitate better bottom cooling and to reduce the frictional pull load so that use could be made of thinner and more infrared-transparent beltings. The moisture always present in the drip troughs under the plate coils, however, presented a definite problem in tunnel sanitation, and this led us on to dewpoint control of tunnel air.

Through several developmental stages there finally evolved the tunnel design. In it fully exposed plate coils are positioned horizontally above and below the product belt, the upper plate carbon-blacked on both top and bottom surfaces. Low-dewpoint air is introduced into the middle section of the tunnel, to slightly pressurize the structure and to exit at both ends with a velocity adequate to prevent outside moisture from entering and causing icing of the plate surfaces. For a tightly constructed, all-metal tunnel carrying a 24 inch belt, adequate pressurization can be achieved with an input of 150 cfm of the low-dewpoint air, while 250 cfm is needed for a tunnel with a 42 inch belt.

The dewpoint control unit comprises in a series:

1. a 33°F. brine precooling coil
2. two silica gel beds for alternating between air drying use and heat regeneration
3. a post-cooling brine coil
4. electric finned air heaters
5. blowers and automatic change-over equipment for continuous operation.

A dewpoint of tunnel air at least 20°F. below the temperature of the plate coil surface has been found necessary to prevent slow icing of the coils' carbon blacked surfaces. By proper depth and area of silica gel bed, dewpoints as low as −80°F. can be obtained, allowing operation of the radiant-receiving plate coils as low as −60°F. if desired for rapid or low temperature cooling.

Use is limited

This design of low-temperature radiant cooling tunnel is limited in use to the cooling of materials not themselves exuding appreciable moisture. It is fully applicable to the cooling of chocolate coatings, moulds and cakes, with plate coils as low as 0°F. and a hardening time of about 4 minutes for coatings. Such rapid cooling cannot be achieved safely with cold air currents, for the chilled surface layer fats crystallize while the deeper layers are still liquid. The large amount of latent heat liberated later by crystallization of the deeper layers liquifies some of the surface layer crystals to produce the unwanted "bloom". Such does not take place even with the most rapid through-and-through radiant cooling.

Hard candies can also be cooled in this type of tunnel, for their contained water is in bound form as hydrate films around the hydrophilic solids. Here the change from liquid to solid is of the gradual, glassine type of internal organization with a continuous release of ultra-long wavelength latent heat.

Radiantly cooled chocolate coatings have a higher surface gloss, better crystalline structure, greater resistance to "bloom", and longer shelf life than those hardened by conventional cold air currents. These advantages of radiant cooling seem to hold just as well when the carbon-blacked receiving plate coils are above freezing temperatures as when they are maintained at 0°F. or below for very rapid cooling. They seem related to emission of radiant heat from all layers of the hardening coating directly to receiving blackened plate coils and the more spontaneous crystallization of the coating's fatty constituents. The advantages of low temperature receiving plate coils (0°F. or below with dewpoint control) have to do only with a shortening of cooling time and either a greater product flow or a reduction in valuable floor space.

It seems obvious that the shorter wavelength infrared radiations emitted by cooling chocolate coatings exit directly not only from the exposed surfaces but also in progressively lessened intensity from sub-surface layers. Radiant cooling performances for chocolate coatings always exceed that expected from application of the Stefan-Boltzmann formula for black-body surfaces. Much further study is needed here in order to reach a clearer quantitation of the extent of such sub-surface radiation for various types of organic or mineral materials.

Radiant cooling of hard candies

The principles involved in the radiant cooling of hard candies differ little from those described for chocolate coatings, except for a smaller and more gradual *latent* heat release. The water content here is in the main held tightly bound by the sugar molecules and in the crystal lattice as it progresses gradually through its glassine-type formation. Here again there is a very considerable sub-surface radiation which gives radiant cooling performance better than would be expected from application of the Stefan-Boltzmann formula for black-body surface radiation.

Radiant cooling in still dry air carries sharp advantages over conventional cold air systems for hard candy coatings, mainly because of the candy's tendency to absorb air moisture and to form a semi-liquid sticky surface. In most conventional air cooling systems operating at low temperatures for rapid cooling, the wet-bulb temperature of the air is not far below the dry-bulb temperature, so that the air has a high relative humidity.

The hygroscopic candy sugars show a strong tendency to absorb moisture from such cold "wet air", with a dissolving of the surface sugar layers into a sticky liquid film. Here again, low temperature radiant cooling with dewpoint control carries sharp operational advantages.

Removal of the amount of heat required for necessary hardening can perhaps be accomplished no faster by radiant cooling than by convective air cooling, but with radiant cooling there is more direct cooling of sub-surface layers and a much less sharp temperature difference between surface and center—which means less of the destructive checking and cracking of surface layers.

Since studies on radiant cooling are now in progress in several European laboratories, perhaps a few

words of caution here might prevent confusion and apparent conflict between different investigators.

The only published findings coming to my attention have been those carried in the article by Goerling, Becker and Heiss working in the Institute of Food Technology and Packaging in Munich (2). These investigators claimed to find no essential differences, either in cooling time or product characteristics, between radiant cooling and convection cooling of chocolate. While the article itself carried no explanation for the lack of differences, direct query to Dr. Heiss elicited further details of the experimental set-up which indicated that radiant cooling was proceeding uninhibited to at least 95% of its full capacity during the test periods they were labelling as convection cooling.

Use reflective surfacings

While the test chamber of Goerling, et al was well designed to study almost pure radiant cooling, their adaptation of it for supposedly convection cooling allowed relatively free egress laterally (by reflection from the foil-lining surfaces) for heat rays emanating from the warm chocolate being hardened. It is a difficult and technical matter to inhibit completely radiant emissions from a cooling product while at the same time facilitating convection cooling.

Very skillful use of reflective surfacings is indeed necessary to be certain that all heat radiations emitted from the product are turned back inward so that there be a minimum of net radiant loss. Even in the best designed radiant cooling tunnel, for instance, there still exists a small degree of convective cooling arising from temperature difference between warm product surfaces and cooler contiguous, essentially still air. In air cooled tunnels a large portion of product heat loss occurs by direct radiation to inside tunnel surfacings, there to be picked up by the cold air streams.

Proper tempering

Every chocolate worker appreciates the importance of proper tempering in determining both final product quality and cooling time required to harden it. One cannot speak of anticipated hardening time, however, except with reference to proper tempering at the enrober. In general, it can be said that radiant cooling with blackened plate coils at 0°F. will satisfactorily harden both tops and bottoms of properly tempered dark chocolate coatings up to ⅛ inch thick in 4 to 4-½ minutes of exposure; and milk chocolate coating in 5 to 5-½ minutes.

Compound coatings take approximately the same time to harden as do pure chocolate, even though one would expect a more rapid hardening because of the higher enrobing and hardening temperatures. Higher percentage and slightly different constitution of the fatty fractions of the compound coatings probably account for the discrepancy between expected and observed hardening times.

Additional evidence has recently been obtained that radiant cooling facilitates particularly the formation of the *beta* form of fat crystals in coatings as they harden. Dark coating compound, applied to cakes at 112°F, was cooled in an air tunnel at 39°F and in still air in a radiant batch cooler with carbon-blacked plate coils also held at 39°F. The radiantly-cooled coatings could be safely handled without finger-printing after 3½ minutes of exposure; and the air-cooled coatings after 4 minutes of exposure. When tested within the same hour for resistance to heat breakdown of the crystal structure, however, these apparently well-hardened coatings showed poor resistance to higher temperature exposure.

Air-cooled coatings exposed at 39°F for 4 and 5 minutes, and those radiantly cooled for 3½ minutes, lost essentially all crystalline structure after 65 minutes of exposure in 92°F air. Those exposed for 6 minutes or more in 39°F air, or for 4 or more minutes to radiant cooling were able to resist structural breakdown for 30 minutes at 98°F. The end-point for complete structural breakdown used in these tests was taken as the point at which the coating adhered to the finger or other object brought into contact with it.

Aside from the faster hardening and better gloss and crystal structure with low-temperature radiant cooling, additional benefits come from the maintenance of low dewpoint, essentially still-air conditions in the cooling tunnel. Product and inside tunnel surfaces are kept dry, and deposit of foreign particles on product surfaces is minimized by avoidance of active air currents.

In excluding outside room air from the tunnel interior, it is essential that both feed and discharge orifices of the tunnel be kept within a single room; otherwise pressure differences between air conditioned packing room and warmer enrobing room may cause an end-to-end flow of unconditioned air through the tunnel and result in frosting or icing of the cold plate coils. Stringing table can be extended through the partition into the packing room in most cases, or else the tunnel can be kept entirely in the enrobing room and the packing table extended through the partition to receive the product within the enrober room. This is a factor that cannot safely be neglected in radiant cooling operations at plate temperatures far below room temperatures.

The radiant cooling principles here described are finding useful application in many product fields outside the candy industry. The "freezing" of bacon bellies for slicing is quite analagous to chocolate hardening, and in the freezing of water-contained meats, breads and many other processed foods, the ultra-long wavelength latent heat radiations dominate the cooling picture just as they do with chocolate products.

References

1. **Encyclopedia Britannica,** 1956 Ed., "Atom", Vol. 2, pp. 642-8. "Band Spectrum", Vol. 3, pp. 25-8, "Carbon", Vol. 4, pp. 836-8; "Light", Vol. 14, pp. 57-82; "The Liquid State", Vol. 14, p. 191; "Quantum Mechanics", Vol. 18, pp. 814-827; "Radiation", Vol. 18, pp. 875-883; "Theory of the Solid State", Vol. 20, pp. 945-950; "Spectroscopy", Vol. 21, pp. 180-195.

2. **Theory of Protons and Electrons,** Addison-Wesley Publishing Company, Cambridge, 1955, by J. M. Jauch & F. Rohrlich.

3. Goerling, Von P., K. Becker and R. Heiss, **Gordian.** LIX, gg-1421, pp. 14-19.

How Physical Properties of Candy Affect Taste

BY ERNST R. PARISER, Research Associate, Department of Nutrition
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A survey of the rapidly increasing number of publications dealing with aspects of the manufacture of confectionery products is impressive because of the continuous and significant technological progress that it reflects. A great variety of topics of applied and fundamental research have been investigated. These cover the whole spectrum of industrial activities, ranging from questions such as the handling and storage of raw materials; the blending, preparation and processing of ingredients; the chemical interactions that take place during the manufacturing process and during storage; the finishing, packaging, and shipping of the product—all phases—indeed, right to the final assessment of consumer acceptability. All of these investigations have been carried out with one view in mind: To achieve tangible results in terms of increased profits. These, in turn, can be made only if more candy is sold, i.e. if the consumer appreciates the product.

More perhaps than for many other consumer goods, acceptability of and preference for confectionery products are based on a number of considerations which, except for price, are of a rather intangible nature; that is complex psychological (and sensory), considerations of great importance.

Candy must be attractive to the eye with and without its wrapper, it must feel right and must have the right aroma and the right overall flavor. It is certainly nothing startling to say that the flavor of candy is one of its most important attributes, nor is it unusual to point out that flavor depends upon the choice of ingredients and the processing methods employed during manufacture.

What is, however, of real interest are the questions of *how* and *why* flavor changes are dependent upon composition and manufacturing procedures. Answers to these questions are difficult to obtain but they are important for the candy manufacturer.

If he knew the rules governing the interactions of confectionery ingredients that produce flavor sensations, much time and money would be saved. Unfortunately almost nothing is known of these rules or of the interactions which occur. An understanding of them is the goal of investigations being carried out at M.I.T. and supported by a grant-in-aid from the Sugar Research Foundation.

The problem which we are looking into is this: *What is the effect upon flavor of the various ingredients that go into the manufacture of confectionery products?* The importance to candy manufacturers in obtaining an answer to this question has been emphasized by complaints that: although great effort and much time has been devoted to study of taste sensations induced in solutions, the results obtained had no immediate significance to the candy industry as a whole since most of the work had been carried out with raw materials under experimental conditions in no way related to industrial practice.

The ultimate goal of our enterprise is a translation into objective, quantitative terms of the elusive, subjective factors that govern, in terms of flavor, the general acceptability of a candy product. Far from attempting to supplant the art or experience of the candymaker who has brought confectionery products to a high standard of acceptability we are, rather, trying to determine and understand the fundamental physical, chemical and psychological laws governing the manufacture of such successful products.

As I have said, we have not yet reached our goal and much fundamental work must be done; but we have made a start in what we believe is a profitable direction.

Flavor can be defined as a sensation that is caused by the integration of the taste-, smell-, and touch-stimuli induced by a candy or food product. Flavor thus depends upon many complex and little-understood sensations caused when a food is eaten.

Since it is impossible to study simultaneously the interactions of all sensations produced when we taste, we have restricted ourselves to a study of only two senses—those of touch and of taste. In other words we wish to learn how the sensation of sweetness (since all confectionery products are sweet) is affected not only by the concentration of sucrose and other ingredients which may be present but also by the physical nature of the candy or candy model under study.

Effect of the physical nature of test samples on their sweetness

It is often said that the intensity of a given taste depends upon the concentration of taste material present. This, however, is not always so. I remember my surprise when as a child, I was given a large crystal of rock-salt and found (by putting the whole piece into my mouth) that its salty taste was much more agreeable than that of a much smaller amount of ordinary granulated table salt! Similarly, during our present investigations, panel judges complain of the sickeningly sweet taste of 50% sucrose solutions but greatly enjoy eating a lump of 100% sucrose!

The factor which determined the intensity of taste was not the weight of the taste substance but its physical characteristics. In the cases of the rock-salt and the lump of sugar, the amount of flavorful substance dissolved in the taster's saliva was apparently regulated not only by its rate of solution, but also by the taster himself, who unconsciously swallowed when an agreeable taste intensity was reached. In the case of granulated table salt and, still more, in the case of the 50% sugar solution, the impact of the

dissolved taste-producing chemical was almost instantaneous.

The human organism was denied the possibility of bringing into play any self-regulatory process which could adjust concentrations to the desired pleasant levels. The existence and importance of such self-regulatory mechanisms was realized when we carried out experiments to determine the sugar concentration in the saliva of persons enjoying a hard candy. Although the clear-mint that was tested contained almost 100% sugar, the sugar concentration in the saliva was found to be relatively constant for each person and to vary from person to person between levels of 15% and 25%. These sucrose concentrations apparently represented the highest preference levels for each person and for this particular type of candy.

Taste sensations, therefore, depend not only upon the amount of taste substances present but also upon the physical characteristics of the candy or food. This relationship appears to become more critical when our freedom to control taste intensity decreases. It further appears that man's ability to differentiate between samples containing different concentrations of taste-provoking substances is more acute when solutions are examined than when solid samples are evaluated. These statements are supported by evidence in the following illustrations.

Figure 1. is a summary of evaluations made in our laboratory of sucrose solutions in water. Although solutions do not resemble candy it was necessary to determine the ability of our panel and to relate our results to other investigators who have mainly worked with solutions. Panel members were asked to rank five coded samples in the order of increasing sweetness. The results are shown in the 3-dimensional graphs in which the x-axis represents the concentration of the middle sample in each series. The y-axis represents concentration differences between samples and the z-axis represents the accuracy of the evaluations. The high plateau shown represents the series of sucrose solutions which were differentiated accurately.

Figure 2. is a similar representation of evaluations obtained from starch-sucrose powder mixtures* which contained sucrose at the same levels used in the solutions. This "mountain" has a lower summit and a smaller and less flat plateau than the solution "mountain", thus indicating that the panel's ability to rank sweetness with high accuracy was limited to a relatively smaller range of concentrations. The panel's ability to distinguish between samples was even more limited when 7% gelatin gels containing sucrose at the same concentrations were evaluated. This is illustrated in Figure 3 by a rather steep "mountain" with a relatively small and low plateau.

A summary of evaluations of whipped gelatin samples which contained concentrations of sucrose analogous to those used in the solutions, powders and gels, is presented in Figure 4. These samples roughly approximate marshmallows in texture and appearance and thus may be considered a prototype of candy. As before, it is seen that the panel's differentiating ability is further reduced; i.e., the panel found it more difficult to rank correctly samples of whipped gelatin gels than un-whipped gelatin gels.

On the basis of the experimental evidence shown in these figures it is clear that the "mountains" for

*Prepared from 10X confectioners sugar (containing 3% corn starch) and a bland food grade starch (Fruitfil-Morningstar Paisly Co.)

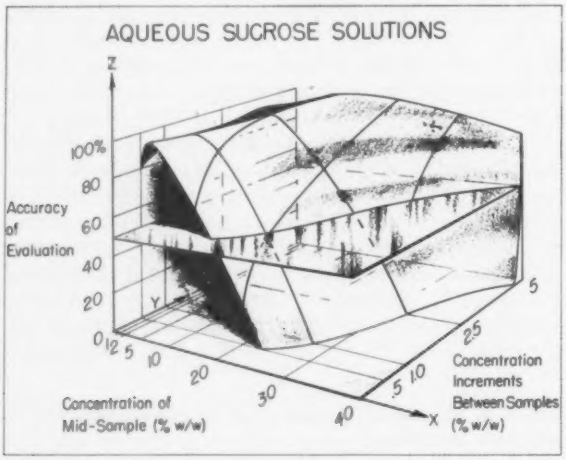


Figure 1

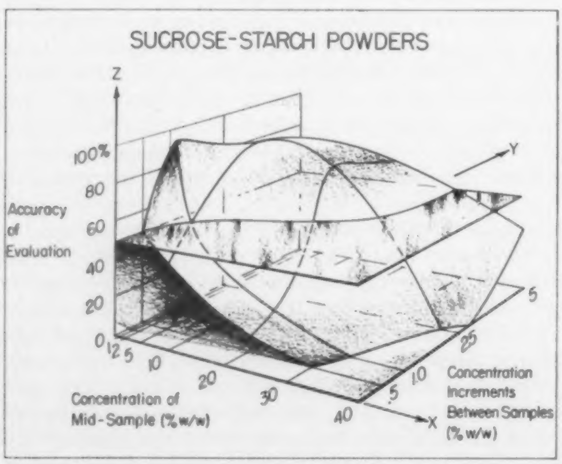


Figure 2

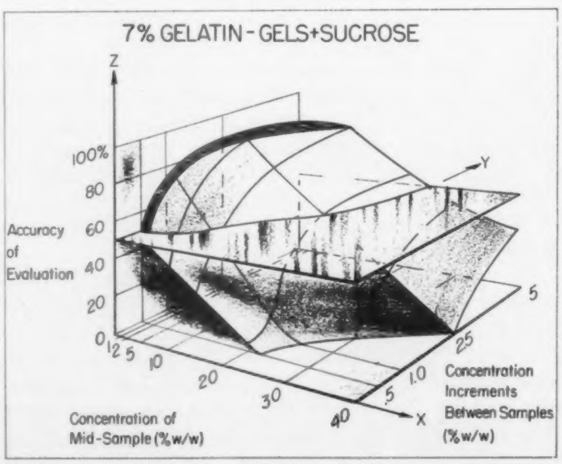


Figure 3

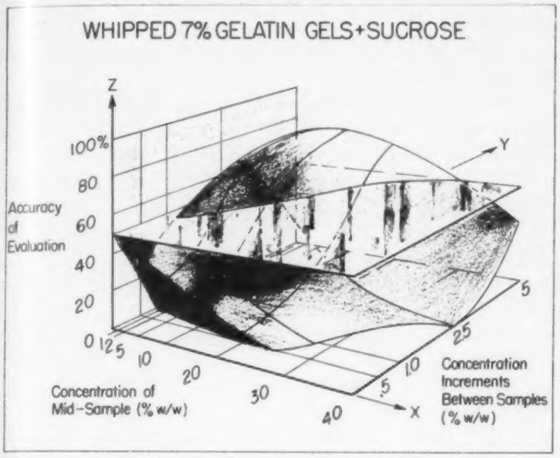


Figure 4

the four models are strikingly similar in character in that the maximum differentiating ability of the panel occurs in all four cases within the same range of sucrose concentrations, (1% to 10%). However, within this range the evaluation of sweetness is easier and more accurate in solutions than in powders, gels, or whipped gels. The steepness of the slopes of the mountains representing solid samples indicates that differentiation of sweetness rapidly becomes more difficult as sucrose concentration increases. In contrast, the solutions were accurately differentiated over a wide range of concentrations.

We believe that these results show in a clear and quantitative manner that the physical nature of a taste sample has a very direct influence upon man's judgement of its flavor. It is also clear that the sweetness of the candy models investigated can only be differentiated with accuracy over a certain range of sucrose concentration. A maximum of information concerning man's ability to evaluate small differences in sweetness should thus be obtained if investigations were directed primarily to candy models which contained sucrose within this concentration range, (1 to 10%). However, such models would not represent candy. The sucrose concentration is much too low. It thus appears that the sweetness of confectionery products must be greatly influenced by the presence of ingredients other than sugar.

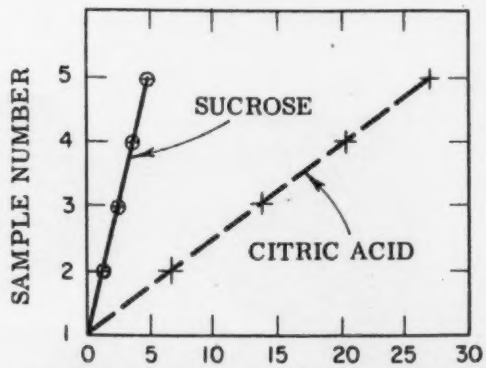
No attempt has been made as yet to determine the acceptability of the candy models studied. Such a determination would be premature. It does, however, appear that a close relationship must exist between acceptability and man's ability to differentiate flavors; if one cannot determine a difference between two substances he cannot prefer one to the other.

Effect of the presence of a basic taste substance on the sweetness of test samples

It has been of great interest to us to determine what effect the presence of other "basic" taste substances might have on a panel's ability to correctly rank the sweetness of our candy models. We have therefore added known quantities of citric acid to series of aqueous solutions and gelatin gels which contain easily differentiable concentrations of sucrose. The panel in each case was again asked to rank coded samples in their order of increasing sensation of sweetness and of sourness. The composition of one of these test series and the panel's evaluation of them are presented in Figure 5. It is seen that in each case the concentration of each taste substance (expressed in multiples of its identification threshold) increases in a regular manner.

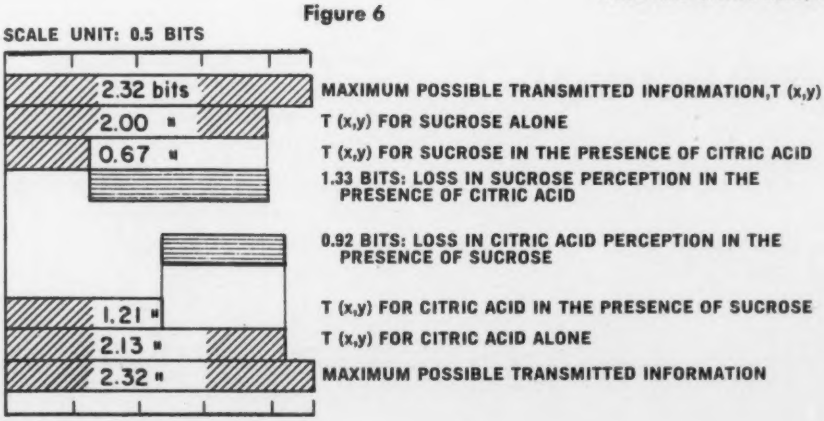
Evaluation and interpretation of the panel's results

Figure 5



CONCENTRATION (IN IDENTIFICATION THRESHOLD MULTIPLES). SCHEMATIC DIAGRAM ILLUSTRATES THE AFFECT ON TASTE PERCEPTION (INFORMATION TRANSMITTED) OF GELATIN GELS CONTAINING SUCROSE AND CITRIC ACID, ALONE OR IN COMBINATION.

Figure 6



has been carried out by application of the concepts of Information Theory. This powerful tool makes it possible to compare the maximum amount of information which can possibly be transmitted about each series of samples with the amount of information actually transmitted about a series, as indicated by the experimental results obtained. For example, as shown in Figure 5 the theoretical maximum transmittable information for sweetness, and for sourness in the gel series is calculated to be 2.32 bits.*

When the panel evaluated the sweetness of the gels *in the absence of any citric acid* they were able to perceive 2.18 bits or 86% of the maximum possible information. However, when citric acid was present at the concentrations shown, their ability to correctly rank sweetness was diminished to only 0.67 bits. This represents a loss of sucrose or sweetness perception of approximately 67%. The presence of citric acid has therefore greatly reduced the panel's ability to differentiate the gels on the basis of relative sweetness.

It is perhaps of equal interest to determine for the same two series, the effect of sucrose on the panel's ability to differentiate sourness. As was said before, the maximum amount of information which can be transmitted concerning sourness if all panel members rank all the samples correctly is 2.32 bits. It was found (Fig. 6) that the panel actually was able to perceive 2.13 bits or 79% of the maximum possible information when citric acid alone was present in the gel sample.

However, when sucrose was present, at the concentrations shown, the panel's perception of sourness was reduced to 1.21 bits—a loss of sourness perception of approximately 43%.

The kind of knowledge that can be obtained by experiments such as those summarized in Fig. 6 appears to us to be very important because it is a quantitative measure of the effect of one taste upon another. This application of Information Theory can be used equally well to evaluate the effects of many different taste substances (added separately or in combination) on a panel's perception of a given taste or flavor. We feel that it can be of great help in obtaining a basic understanding of taste interrelationships.

Summary

It has been illustrated in a quantitative manner that the physical nature of various candy models has a direct influence upon man's judgement of their sweetness. It has also been shown that the sweetness of the candy models is evaluated most accurately within certain ranges of sucrose concentration. Preliminary investigation of the effect of the presence of citric acid on the evaluation of relative sweetness of solutions and of a candy model indicates that quantitative measurement of such effects can be made. It is suggested that examinations of candy models by these procedures can contribute much useful knowledge to the confectionery industry.

*Details of the evaluation of our results by Informational Analysis and an explanation of the meaning of the terms and units used may be found in Quarterly Report, No. 17.

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Illustration, courtesy Champion Paper & Fibre Co.

How to Determine When to Automate Candy Plant

BY RICHARD S. WHITE

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How can the candy industry properly evaluate and achieve the significant gains that are available to it through the continued introduction of optimum automation? There are methods for judging the *degree of automation* that is "feasible" for specific cases of the companies that make up the industry.

Let's take a quick look at the word "feasibility". The dictionary defines it as "the quality of being capable of being done" or ". . . of being *dealt with successfully.*" Many things can be "done" which may not be justified. Therefore, it is this broader implication of "feasibility" (automation that can be "dealt with successfully", in every sense) that must be considered.

One of the problems facing management in authorizing a feasibility analysis is the cost of the analysis versus the possibility of getting a "No" answer from the study. Of even greater importance, a "No" answer puts a roadblock in the path of some objective that management wishes to achieve.

Thus, it can be pretty important to assure the probability that the results of a feasibility analysis will be a positive "Yes, this objective is feasible—both technically and economically."

We believe that a true Feasibility Analysis has two major components:

A. A creative (inventive) analysis of the problem, *coupled* with

B. An arithmetic (or accounting) evaluation of the intended solution.

In contrast to the above, we occasionally find situations in which one group is asked to come up with a solution to an automation objective, and then some other group is asked to evaluate the recommended solution. We believe that this is very much *not* the way to obtain optimum results from feasibility analysis. The thinking of both groups (cited above) is needed in the integrated function of *creating* an affirmative, sound answer to a feasibility analysis.

By combining the two functions of Creative Analysis and Arithmetic Evaluation, the possibility of a negative answer to the feasibility of accomplishing what management wishes to accomplish is dramatically reduced!

What happens in the course of a feasibility analysis for automation? In proposing an answer to this question, we are addressing ourselves to projects which are significant in scope and which require new, or unusual, solutions. We would like to re-emphasize that point; we believe that the approach recommended is particularly applicable to breaking new ground where solutions of the kind intended have not existed prior to the undertaking under analysis.

An Economic and Technical Feasibility Analysis for Automation should include the following four major phases or sections:

A. Definition of the objective.

B. *Creation* of the solution to accomplish the objective.

C. Re-checking the solution for *economic attractiveness.*

D. Balancing the intended program against the risk of the project.

What do we wish to accomplish? The objective is usually to *do* a certain thing: more cheaply, better, or sometimes to find an initial way to perform a sequence of operations. However, this is only a part of the objective. This is what we wish to accomplish, but we must also tie in, "How much *can* it cost?" and/or "How much *will* it cost?"

Now here we need some dollar yardsticks for our creative group to work with. In order to establish these yardsticks there must be trust and confidence between management and the technical group making the feasibility analysis. We would like to emphasize this latter point of mutual confidence. Occasionally a management group has a "price-bettering" approach to the economics of automation that beclouds the

issues and which truly can be the antonym to technical progress and a sound, intellectual effort to find an optimum automation solution.

What is needed? Know the true economic boundaries within which automation will be a sound investment for the company. Then the engineer has dollar yardsticks against which to measure his various inventive ideas from which the correct solution will be created.

Management must be realistic in setting the yardstick for analysis. If they set them too tightly they may force the negative reply, "We do not believe your objective can be met within the dollar framework that you desire." If they set them too wide, they may, in effect, have difficulty in justifying the automation that is contemplated. We have found that most companies in the industries we serve consider a cost to savings ratio of 2 to 3 years to be quite attractive; more specifically, 2 to 3 years of savings, before taxes, equalling the expected cost of the automation program.

In some cases, where an intended automation accomplishment is expected to create a truly significant step forward in a company's operations, we find firms seeing practicality in projects with a 3 to 5 year savings-to-cost relationship.

To highlight the goals or objectives which we believe lie ahead of the candy industry, we repeat a portion of a table* which outlines typical cost compositions of some segments of the candy industry.

Pre-Automation Cost Composition For Some Segments of the Candy Industry

Items	Cost and Profit Composition Relative to Wholesale Price (in %)
Wholesale price (net)	100
Product Material	40.8
Direct Labor	13.3
Indirect Labor	5.2
Packaging Materials	13.4
Manufacturing Overhead	7.5
General Administrative and Sales expense	15.6
Profit (before taxes)	4.2

To summarize defining the objective, the feasibility analysis group must know:

A. What result is desired, and
B. Within what economic boundaries the result must be achieved.

With the above information determined, and if we have the right people making the feasibility analysis, we believe that affirmative results should be achieved with very few exceptions.

To see this more clearly, let us now look specifically at the phase of the analysis which we term "Creating the Solution" and its corollary, "Re-checking the Solution for Economic Attractiveness." We believe you will see that these are the inter-related factors which must be utilized together to create the right solution.

Start with a creative—inventive—analysis of the problem on hand. How can our objective be accomplished? If it isn't being done now, it is a matter of inventing a solution. Nothing can truly proceed until we have invented a solution. Here great attention must be given to bringing the correct skills and inventive ability to bear on the problem.

Depending upon the scope and sophistication of the problem, the solution may require the inventive thought of more than one person. We may have to search out the answer through many of the sciences to find the particular answer which enables us to optimize the replacement of human discernment and skill with automated apparatus. Occasionally we have all of the answers to put the solution together but for one "missing link." We doubt, however, that there is a missing link that cannot be found in most of the significant costs remaining in candy manufacture. In fact several firms have found, or have set about finding, the missing links to many of the remaining major costs.

We have emphasized invention because we are primarily discussing projects whose nature requires invention, but the need for invention often goes beyond that which may seem apparent. We may think that some previously found solution, perhaps in the form of relatively standard equipment, may be the

Chart I
Production Data

Product Number	Annual Production In Number Of Units	Pieces Per Unit	Number of Operators	Units Per Minute	Production Minutes Per Year	Operator Minutes Per Year
1	630,322	29	15	19	33,184	497,260
2	169,244	29	15	19	10,180	152,700
3	103,170	66	15	12-2/3	4,202	53,030
4	21,417	114	20	6-1/3	3,383	67,660
5	28,086	114	20	6-1/3	1,479	29,580
6	33,227	39	20	19	1,749	34,980
7	18,194	39	20	19	958	19,160
8	255,951	32	17	19	13,471	229,007
9	102,708	36	19	19	5,406	102,711
10	43,609	36	19	19	2,295	43,605
11	277,478	45	23	19	14,605	335,915
12	152,422	48	25	19	8,002	200,550
13	125,535	48	25	19	6,607	165,175
14	126,740	64	24	12-2/3	10,003	240,072
15	93,526	64	24	12-2/3	7,382	177,168
16	112,103	57	20	12-2/3	8,848	176,960
17	98,565	57	20	12-2/3	7,779	155,580
18	71,565	66	24	12-2/3	6,455	154,920
19	35,406	44	23	12-2/3	5,589	138,547
20	70,164	90	23	9-1/2	8,441	194,143
21	38,318	15	16	38	2,305	36,880
22	45,444	90	23	9-1/2	5,467	125,741
23	25,008	68	24	9-1/2	1,316	31,584
24	107,114	66	23	12-2/3	8,454	194,442
25	47,436	129	23	6-1/3	3,747	86,181
ETC.						
103	5,282	86	22	9-1/2	278	6,116
104	3,841	44	21	18	213	4,473
105	860	44	21	18	48	1,008
106	3,601	(44)	21	18	200	4,200
107	3,801	(66)	25	12-2/3	200	5,000
108	3,370	(86)	25	12-2/3	133	3,325
109	1,562	(86)	9	87	...	2,175
110	724	(86)	25	9	40	1,000
111	666	(86)	25	9	37	925
112	100	(86)	25	9	6	150
113	341	(44)	26	18	19	494
114	240	(44)	26	18	13	338
115	4,804	66	25	12-2/3	253	6,325
116	2,160	66	25	12-2/3	114	2,850
117	2,340	68	25	12-2/3	123	3,075
118	2,164	68	25	12-2/3	114	2,850
119	925	(68)	25	12-2/3	49	1,225
120	525	(68)	25	12-2/3	28	700
121	1,021	68	25	12-2/3	54	1,350
122	1,500	68	25	12-2/3	8	200
	5,102,296				319,258	6,587,783

*Published in an article written by the author and published in "Candy Industry and Confectioners Journal," November 22, 1960.

solution to our automation needs. But, if in fact, it economically is not the solution, then we merely have determined that that *one* solution is not the answer to an automation need. We have *not* determined "affirmative" or "negative" as to the feasibility of automating an operation unless our analysis has included *inventive analysis!*

We mentioned earlier the importance of setting some yardsticks for measuring feasibility. These yardsticks guide the creative problem analyzer. They are points of reference to which he returns periodically in his technical thinking. From them he determines if the *directions* which his ideas are taking, actually appear as though they would fall within the boundaries defined by applying the yardsticks. We have developed a tool which both aids the definition of the economic problem to be eliminated (where that is part of the objective) and which greatly facilitates applying economic analysis to forming the technical solution and the alternatives. This tool is particularly advantageous where the analysis covers a multi-product requirement.

Basically, the cost factors associated with each product are broken into "operator-minutes." From the pre-automation costs, we determine the operator-minutes required to produce each product in an annual period. This then enables various alternative solutions to be tested in terms of the *percentage of total aggregate Operator-Minutes that will be saved* for the total number of products involved.

Chart I shows an analysis of this type. In the example shown, which portrays an automated candy packing line of different products, there is considerable variation in units per year. The use of operator-minutes enables us to give appropriate weight to the cost effect of each of various products. This is particularly important where technical alternatives have varying effects on different products in a multi-product system. In such a multi-product system we, of course, are endeavoring to obtain an optimum saving for the entire system. This can be quite different than the technical system which will give the most savings for the most *number* of products, particularly where annual volumes vary to the extent of the example shown.

Chart II
Operating Pattern
AT VARIOUS PIECE CAPACITY OF AUTOMATION EQUIPMENT

	Number of Pieces	Operator Annual Minutes Accounted For	
Assortment—Numbers	**Per Unit(2)**	**Minutes**	**%(1)**
1, 2, 9, 10, 25, 43-48, 63-66 packed completely plus 33 pieces in all other assortments.	33	4,216,333	64.1%
1, 2, 9-12, 25, 43-50, 63-66 packed completely plus 38 pieces in all other assortments.	38	4,636,132	70.7%
1, 2, 7-12, 23, 25, 43-56, 63-66, 69-78, 91-93, 96-101, 104-106, 113, 114 packed completely plus 44 pieces in all other assortments.	44	5,123,836	78.1%

(1) % of total years minutes
(2) The figures in this column represent the number of pieces to be packed automatically.

Chart III
Possible Operating Pattern with Technical Alternative B

	At Number of Pieces	Operator Annual Minutes Accounted For	
Assortment Numbers	**Per Box(2)**	**Minutes**	**%(1)**
1-6, 9, 10, 19-22, 25, 28, 29, 39-48, 63-66, 79, 80, 85, 86, 115, 116 packed completely plus 33 pieces in all other assortments.	33	5,534,412	84.4%
1-6, 9-12, 18-22, 25, 27-29, 39-50 79, 80, 85, 86, 115-122, 66-66 packed completely plus 38 pieces in all other assortments.	38	5,998,118	91.1%
63-66, 1-12, 18-23, 25, 27-29, 35-56, 69-78, 91-101, 104-106, 113-122 packed completely plus 44 pieces in all other assortments.	44	6,328,752	96.4%

(1) % of total years minutes
(2) The figures in this column represent the number of pieces to be packed automatically.

Chart II shows the alternative savings that can be obtained with varying degrees of automation. Here again is a portrayal of the valuable use of the operator-minute analysis. We are able to describe the quantity of savings as a percentage of the operator-minute cost existing prior to automation. The savings alternatives shown can then be measured against the estimated cost for each of the three degrees of automation to which they relate. Then the optimum point of the savings-cost relationship can be determined with management. Also qualitative considerations which can be super-imposed upon the specific quantitative optimum point.

Chart III shows a further interesting progression

Chart IV

Product Number	Annual Production In Number Of Units	Line Minutes Per Year	AEL Automated Line Labor Minutes Per Year	Present Labor Minutes Per Year	Savings Labor Minutes Per Year
1	2,390,000	80,116	843,680	3,180,500	2,333,820
2	842,000	27,500	282,000	1,490,000	1,208,000
3	226,500	7,400	60,330	442,100	371,770
4	105,000	3,480	52,200	214,000	161,800
5	179,000	5,910	85,900	328,200	242,300
6	65,000	2,170	23,870	92,020	68,150
7	177,000	5,900	47,200	229,340	182,140
8	155,000	5,170	108,507	316,400	207,893
9	45,500	1,515	27,270	82,400	55,130
10	148,500	4,950	113,850	319,000	205,150
11	94,000	3,135	43,862	126,800	82,938
12	55,500	1,850	25,900	92,460	99,560
13	123,167	4,107	41,070	196,100	155,030
14	60,000	2,000	36,000	370,000	334,000
15	65,300	2,180	30,520	100,720	70,100
16	43,200	1,440	15,840	67,800	51,960
17	36,000	1,200	14,400	56,540	43,140
18	35,600	1,190	13,090	55,890	42,800
19	22,400	950	7,500	32,660	25,170
20	30,600	1,020	8,160	35,180	27,020
21	20,000	670	5,360	24,000	18,640
22	25,000	835	9,185	39,350	30,065
23	114,000	3,800	45,600	186,200	140,600
24	40,000	1,335	12,015	68,050	56,035
25	310,000	10,340	173,080	989,740	816,660
26	25,000	835	12,525	45,300	32,775
27	7,500	250	5,250	15,310	10,060
28	30,000	1,000	9,000	59,800	50,800
29	34,000	1,135	13,620	58,800	45,180
	5,467,292	189,933	2,186,944	9,314,560	7,134,986

in the analysis of this candy automation example. Here we see that by challenging our ingenuity further, we are able to make slight variations in the recommended automation system which augment the savings for each of the three degrees of automation by nearly 20% in each case. This Chart III, compared to Chart II, shows how we can have a clear picture of the variation in economic consequence of alternative technical solutions. We believe this point highlights the need for the technical feasibility and economic feasibility to be analyzed by a single group rather than two groups.

Another candy automation example is shown in Chart IV. The final system after various alternatives had been considered is given. Here you see the operator-minute analysis of the cost structure before automation (again for a multi-product system). Adjacent to these figures are the expected cost structure following automation. Next to these figures are shown the savings that automation can achieve.

Having reached the stage where we have specific methods in mind, we are in a fairly good position to estimate the costs of the automation program. We all know that estimating is one of the toughest parts of the development or inventive business. However, by breaking the program down into the various steps of development: Invention, prove-out, design, and fabrication, and then estimating each of these steps in sensible detail, we can achieve practical estimates.

Recognize the estimate

Perhaps one of the most important aspects of the estimate is that it should be recognized for exactly what it is. That it is an estimate and that an important factor in viewing an estimate is to consider the probable variation that could occur from the estimated figure.

On a project which is quite novel and which represents work to be done considerably different from other automation achievements, we believe that the estimated or "target" figure can be achieved within a correctness of 50% or better. That of course is a mighty significant percentage. But for the analysis group, the development group, or management to expect the estimate for novel projects will necessarily be within a tolerance of less than 50% can be a mistake.

However, many automation programs can be accomplished within about 20% of the estimated or "target" cost, depending upon the degree of novelty involved.

One might ask, "If you believe an estimate is good within 20%, why not add the 20% to the estimated cost?" The full answer to that point is fairly complex, but those of you who have done development work where an effort is made to keep the costs under control, know that the presence of that estimate (treated as a figure you're not supposed to exceed) has a great deal of practical motivating force, including the motivation to keep inventing ways to get the job done soundly and within the estimate.

The analysis group should give management their best estimate along with their evaluation of the "limits" within which the estimate should stay. Management should then be cognizant of the expected "limits of accuracy" in its evaluation, and the basic estimate should be the "target" for the project.

Having presented the above premise for stating estimates, let us add another point relative to evaluating economic feasibility. Referring back to the points outlined under the discussion of the project's objectives we cited that in many cases the savings-cost objective can be stated as a cost which will be repaid in 2 to 3 years of savings. Correlating *that* observation pertaining to the "limits" of accuracy of an estimate, we always endeavor to obtain a creative solution, for such a 2 to 3 year objective, that should be possible of amortization within 2 years. With that "tightened-up" objective in prospect, we then can live with the reality of the fact that a project could run over the "target" cost by 50% *and still be within the 3 year cost recapture of the initially stated objective.*

We now have covered considerations of the objective, creating the desired automation solution, economically measuring the intended result, and estimating the cost of achieving the result. When we have proceeded this far and can compare the dollar savings expected with the estimated cost, we can see whether we have moved toward a positive answer to the feasibility analysis.

By coupling a creative analysis of the problem with an arithmetic or accounting evaluation of the results to be achieved, the possibility of getting negative results to a feasibility analysis is dramatically reduced.

If we are not in balance toward a positive answer at this point in a feasibility analysis, we can review the analysis to determine where the imbalance lies. Usually, if we do not yet have a positive result, it means that we must go back to the creative aspect of the analysis and put our minds to inventing a better solution that will give greater savings and/or at lesser cost. In other words, if we don't yet have the answer—the answer lies in further and better invention. There is seldom a case in which positive feasibility cannot be determined unless we reach a block where we simply cannot adequately invent the right technical solution for the economic requirements to be met.

A point which is still rather formative in our experience, but which is an observation that may be of value is: we find there is a considerable degree of probability, of feasibility success, when the objective is based upon the 2 to 3 year payoff relationship cited above. We suspect the reason we are usually able to achieve results within those boundaries, is that the amount of engineering and manufacturing effort required to produce automation results usually has some comparability to the amount of human effort that is required to do any particular manufacturing sequence prior to full automation. We can usually engineer and produce an automation system at a cost comparable to 2 to 3 years of wage costs involved in a manufacturing system before the application of automation. In the candy industry this statement can be modified to state the probability of the 2 to 3 year relationship for packing automation and a 3 to 4 year relationship for process automation.

The fourth phase of a feasibility analysis is "balancing the intended automation program (and its

economic attractiveness) against the risk of that program". We believe there are two basic elements involved in balancing against risk. One of these was covered above in the discussion of estimating the cost; namely, an adequate estimating allowance for some of the objectives that are more difficult to achieve than anticipated.

The other aspect of balancing against risk is deeply involved in the technical requirements of the project. A critical review of the basis of the solution will bring to the fore, the critical or controlling links of the solution. The attention of the analysis group, the development group, and management should be focused on these "critical links." They should be highlighted in the feasibility analysis, and the steps necessary to remove the risk of the critical links should be outlined as part of the feasibility analysis.

Briefly stated, we recommend that the functionability of the "critical links" of the solution be "proven-out" at the very inception of an automation project. The recommendation that this be done, and an inventive outline of how to do it for the particular project is an urgently important portion of a complete feasibility analysis. Furthermore, in maintaining control of "feasibility," money should be appropriated only for proving-out the "critical links" of the project until those critical links have, in fact, been proven-out and operability demonstrated to management. We have found that the critical links of most projects can be proven-out and demonstrated to management within a cost range of 10% to 20% of the overall cost of an automation project.

This is a tremendously important facet of the total subject of feasibility—of having "the quality of *being capable of being dealt with successfully.*" If the feasibility group can foresee that the critical links can be proven-out within 10% to 20% of the total project cost, and that at that cost level, management will be able to *see* assurance of technical success, this brings into the realm of being feasible many projects which otherwise might not be feasible considering the factor of risk.

Summary

Thus, the above procedure for economic and technical feasibility analyses for candy plant automation recommends:

a. Definition of the objective, including stating appropriate yardsticks.
b. Creating the technical solution, via inventiveness.
c. Re-checking the solution for economic attractiveness, often using an "operator-minute" analysis.
d. Balancing the intended automation program against the risk involved to achieve the program, including recommendations for proving-out the "critical links" in the project.

We believe that the above procedure creates a constructive and healthy environment for success in the field of candy plant automation. It is a procedure and environment that is highly important to permit rapid strides towards higher degrees of candy plant automation possible in the era of technical evolution ahead.

CALENDAR

May 12; Los Angeles Confectionery Sales Club, 12:00 noon, Rodger Young Auditorium, Los Angeles, Calif. Election of Officers.

May 13; Carolina Confectionery Salesmen's Club, Ladies' Day—luncheon session. Speaker: CBA Executive Secretary L. Blaine Liljenquist.

May 14-17; Flavoring Extract Manufacturers' Association, 52nd annual convention, Savoy Hilton Hotel, New York, New York.

May 15; Flavoring Extract Manufacturers' Association of the United States, Annual Golf Tournament, Mount Kisco Country Club, Mount Kisco, N. Y.

May 15; Confectioner's Salesmen's Club of Philadelphia, 1:30 p.m. meeting, 2601 Parkway, Philadelphia, Pa.

May 16; Chicago Section AACT, dinner dance, Butterfield Country Club.

May 26; Boston Confectionery Salesmen's Club, Inc., Kenmore Hotel, Boston

May 27; Philadelphia Section, American Association of Candy Technologists, 5:00 p.m. Plant visitation to Royal-Pioneer Paper Box Mfg. Co., Inc., followed by dinner at plant, with Royal-Pioneer Paper Box as host.

May 27; Southwestern Candy Salesman's Association, 12:00 luncheon, Sammy's Oak Lawn Restaurant, Dallas, Texas

June 1-2; Manufacturing Confectioners' Traffic Conference, Semi-Annual Meeting, Boston, Mass.

June 2; The Central Pennsylvania Candy Salesmen's Club, Annual Spring Dinner-Dance and Golf Outing, Hershey Country Club, Hershey, Pa.

June 2; St. Louis Candy Sales Association, 7:30 p.m., Congress Hotel, Union & Waterman Ave., St. Louis, Mo.

June 5; Denver Mile Hi Candy Club, 7:45 a.m. Breakfast meeting, Denver Athletic Club, Denver, Colo.

June 5; Retail Confectionery Association of Philadelphia, Inc., Dairy Maid Restaurant, 6:30 p.m. dinner meeting, Philadelphia.

June 11-14; Associated Retail Confectioners of North America convention, Drake Hotel, Chicago, Ill.

June 11-15; National Confectioners Association, 78th annual convention, Conrad Hilton Hotel, Chicago.

June 14; Regional Technical Conference, Society of Plastics Engineers, Montreal, Quebec, Canada.

June 17-19; Candy Salesmen's Club of Philadelphia Annual Candy Show, Benjamin Franklin Hotel, Philadelphia.

June 18-20; Food Brokers Management Conference, St. Francis Hotel, San Francisco.

June 19; Confectioner's Salesmen's Club of Philadelphia, 1:30 p.m. meeting, 2601 Parkway, Philadelphia, Pa.

June 22; Annual Baltimore Candy Day outing, Conrads Ruth Villa, Baltimore.

June 22-25; Boston Confectionery Salesmen's Club, 16th Annual Convention, Mayflower Hotel, Plymouth, Mass. (The Group is celebrating its 32nd Anniversary this year.)

June 23-24; The Badger Candy Club's 12th Annual Candy Carnival, Pfister Hotel, Milwaukee, Wis. (Attend Braves-Cubs Baseball game, evening of June 23; followed by buffet and entertainment in Old English Room of Pfister Hotel). Exposition in Exhibition hall of Hotel, June 24 from 10:00 a.m.–5:30 p.m. Social hour in evening.

July-August; No meeting of Retail Confectionery Association of Philadelphia, Inc.

July 16-19; National Confectionery Salesmen's Association annual convention, Atlantic City, N. J.

July 23-26; National Candy Wholesalers Association, annual Convention, Palmer House, Chicago, Ill.

Aug. 20-23; Fancy Food and Confection Show, Astor Hotel, New York City.

Aug. 26-29; Boston Candy Show, Statler Hotel, Boston.

Sept. 28-Oct. 2; Retail Candy and Allied Products Show of NCSA, New York Trade Show Building, New York City.

Oct. 18-20; National Packaging Forum, 23rd Annual, Biltmore Hotel, New York City.

Oct. 28-31; National Automatic Merchandising Association, Annual Exhibit-Convention, McCormick Place and Conrad Hilton Hotel, respectively, Chicago.

November 7-10; Packaging Machinery Manufacturers Institute 1961 Trade Show, Cobo Hall, Detroit, Mich.

Dec. 1-3; National Automatic Merchandising Association, Western Conference and Exhibit, Ambassador Hotel, Los Angeles, Calif.

Feb. 27-28, March 1, 1962; Western Candy Show and Convention of National Candy Wholesalers Association, Flamingo Hotel, Las Vegas, Nevada.

Sept. 8-16, 1962;–International Food Congress, 5th, New York Coliseum, New York City.

The MANUFACTURING CONFECTIONER'S

Candy Clinic

The Candy Clinic is conducted by one of the most experienced superintendents in the candy industry. Some samples represent a bona-fide purchase in the retail market. Other samples have been submitted by manufacturers desiring this impartial criticism of their candies, thus availing themselves of this valuable service to our subscribers. Any one of these samples may be yours. This series of frank criticisms on well-known branded candies, together with the practical "prescriptions" of our clinical expert, are exclusive features of The MANUFACTURING CONFECTIONER.

Easter Candies; Cordial Cherries

Code 5A1
Dark Chocolate Coated Cordial Cherries
¾ lb.—$1.39

(Purchased in a retail candy shop, St. Louis, Mo.)

Appearance of Package: Good
Container: Long, oblong box, one layer type. Red glazed paper top, printed in red, white and dark green. Imprint of cherries on top in color. Paper wrapper overall printed in gold.
Appearance of Box on Opening: Good
Number of Pieces: 25 cherries, 2 cherries foil wrapped.
Dark Coating: Good
Gloss: Good
Strings: Good
Taste: Good
Center:
Cordial: Very Good
Cherries: Good
Flavor: Good
Remarks: The best cordial cherries we have examined this year.

Code 5B1
Speckled Eggs
1 lb.—49¢

(Purchased in a department store, St. Louis, Missouri)

Sold in Bulk:
Eggs:
Colors: Good
Panning: Good
Finish: Good
Jacket: Good
Center: Coconut cream
Color: Good
Texture: Good
Taste: Good
Remarks: A good eating egg of this kind. Good workmanship.

Code 5C1
Filled Hard Candy Sticks
12 ozs.—$1.00

(Purchased in a retail candy shop, St. Louis, Mo.)

Appearance of Package: Good
Container: Acetate container and top. Foil seal printed in green.
Sticks:
Colors: Good
Gloss: Good
Center:
Cream: Good
Color: Good
Texture: Good
Flavors: Good
Remarks: The best flavors we have tasted in hard candy in some time. Very fine eating and good workmanship. Highly priced at $1.00 for 12 oz.

Code 5D1
Assorted Chocolates
1 lb.—$1.45

(Sent in for analysis)

Appearance of Package: See remarks
Container: Oblong box, one layer type. Buff paper top with dark brown border, printed in green and dark brown. Cellulose wrapper.
Appearance of Box on Opening: Good
Number of Pieces:
Light Coated: 14
Dark Coated: 16
Foiled: 1
Coatings:
Colors: Good
Gloss: Good
Strings: Fair
Taste: Good
Dark Coated Centers:
Strawberry Cream: Dry and hard
Vanilla Caramel: Good
Vanilla Fudge: Good
Hard Candy Nut Paste Blossom: Good
Buttercream: Good
Nut Toffee Chip: Good
Nut Nougat: Good
Coconut Paste: Good
Chocolate Buttercream: Good
Orange Cream: Weak flavor
Cordial Cherry, Foiled: Good
Light Coated Centers:
Solid Chocolate & Raisins: Good
Vanilla Caramel: Good
Chocolate Nut Fudge: Good
Nut Nougat: Good
Solid Chocolate & Nuts: Good
Nut Crunch: Good
Nut Cream: Dry and short
Coconut Cream: Good
Assortment: Good
Remarks: One of the best samples of assorted chocolates we have examined this year in this price field. Suggest

Candy Clinic Schedule For the Year

JANUARY—Hard Candies
FEBRUARY—Chewy Candies; Caramels; Brittles
MARCH—Assorted Chocolates up to $1.15
APRIL—$1.20 and up Chocolates; Chocolate Bars
MAY—Easter Candies; Cordial Cherries
JUNE—Marshmallows; Fudge
AUGUST—Summer Candies
SEPTEMBER—Uncoated & Summer Coated Bars
OCTOBER—Salted Nuts; Gums & Jellies
NOVEMBER—Panned Goods; 1¢ and 2¢ Pieces
DECEMBER—Best Packages and Items of Each Type Considered During the Year.

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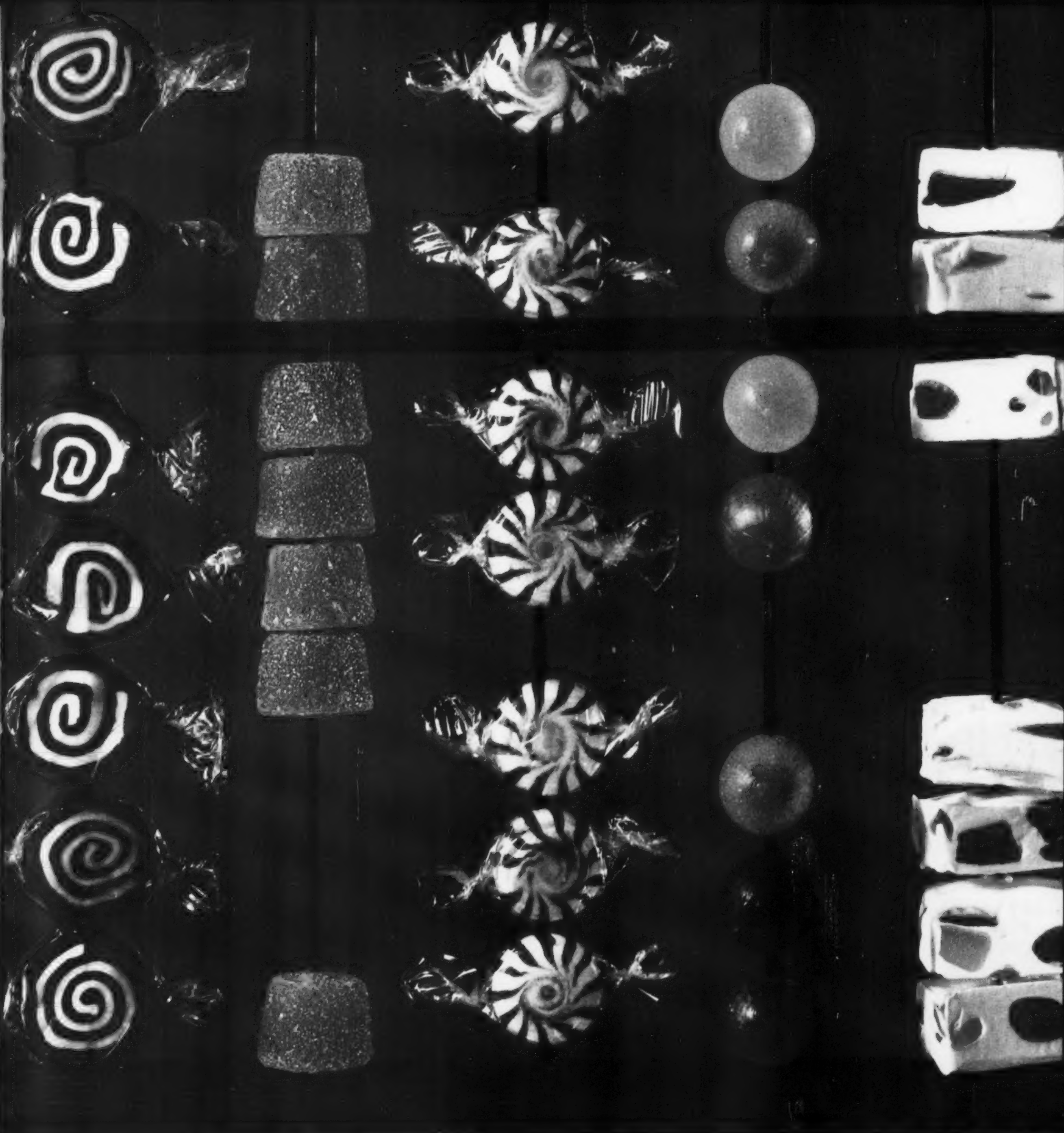

more colors be used in the top to make the box more attractive.

Code 5E1
Assorted Chocolate Coated Eggs
12 eggs—98¢

(Purchased in a retail candy shop, St. Louis, Missouri)

Appearance of Package: Good
Container: Oblong box, one layer type, large window in the shape of rabbit. Top printed in purple, blue, white and yellow. Sealed with cellulose tape on sides.
Appearance on Opening: Good. Eggs were in a molded plastic tray, yellow colored.
Number of Eggs:
Chocolate Coated Eggs: 8
Foiled Chocolate Coated Eggs: 2
Coating, Dark:
Color: Good
Gloss: Fair
Taste: Good
N.B. Some eggs had chopped nuts on top and some had green sprinkles on top.
Centers: All cream
Colors: Good
Texture: Fair. Slightly dry
Flavors: Not up to standard.
Remarks: Suggest a better grade of flavors be used. Also suggest cream centers be checked as they are not up to the standard of other cream eggs we have examined in this price field.

Code 5F1
Assorted Chocolate Covered Eggs
11 ozs.—98¢

(Purchased in a retail department store, St. Louis, Missouri)

Appearance of Package: Good
Container: Oblong box, one layer type. White paper top printed in Easter colors. Tied with yellow and green grass ribbon.
Appearance of Package on Opening: Good
Number of Eggs: 12 eggs:
8 Chocolate coated
4 Confectionery coating
Coating:
Chocolate: Good
Confectionery: Good
Centers, Cream: Good
Flavors: Good
Remarks: Very good eating eggs.

Code 5G1
Milk Chocolate Hollow Egg
2 ozs.—25¢

(Purchased in a chain variety store, Chicago, Ill.)

Wrapper: Egg is wrapped in blue foil; paper rabbit head on top, yellow seal printed in red.
Size: Good
Egg:
Chocolate: Good
Molding: Good
Taste: Good
Remarks: A good looking Easter novelty.

Code 5H1
Marshmallow Bunnies
1¼ ozs.—10¢

(Purchased in a chain drug store, Chicago, Ill.)

Appearance of Package: Good
Container: Maroon colored tray, printed in yellow and white. Overall cellulose wrapper.
Bunnies: 3 pieces
Color, Pink: Good
Molding: Good
Sugaring: Good
Texture: Good
Taste: Good
Remarks: A good looking 10¢ Easter novelty. Very good container for a piece of this kind.

Code 5L1
Chocolate Coated Marshmallow Eggs
5⅛ ozs.—39¢

(Purchased in a chain variety store, Chicago, Ill.)

Appearance of Package: Good
Container: Oblong tray printed in yellow and purple. Overall cellulose wrapper.
Eggs: 12 pieces
Coating: Good for this priced package
Center: Marshmallow
Color: Good
Texture: Good
Taste: Good
Remarks: A large looking package but a trifle high priced at 39¢.

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fmc ...first in Pouch Packaging

announces the

STOKESWRAP "1000"

the completely new pouch-forming, filling and sealing machine with almost unbelievable versatility!

From FMC—who introduced pouch-packaging equipment and developed Stokeswrap, the standard of the industry — now comes the new "1000," a double-tube machine with all the advantages of two single-tube machines, but at less cost. The many new design features of the "1000" give the equipment an amazing flexibility that makes it ideal for large and small plants alike.

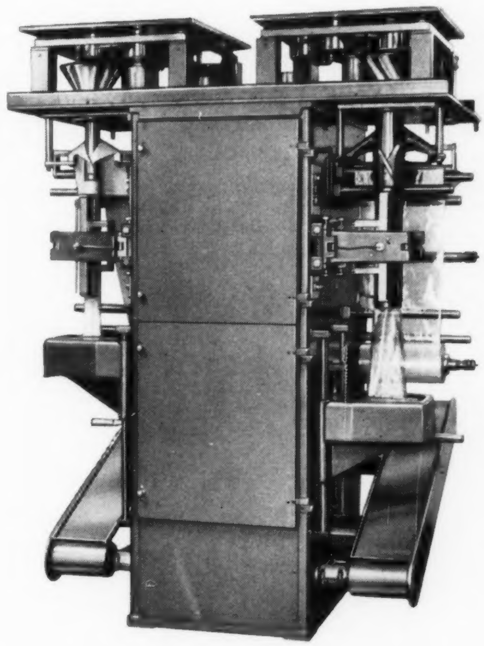
In addition to including all the proven Stokeswrap features for packaging free-flowing products such as frozen foods or candies, the "1000" has been designed to be the most versatile pouch-making machine available.

The amazing versatility of the "1000" is due to the separate drives that make it possible to operate either of the two tubes independently of the other.

The "1000" can simultaneously . . . run two different types of film . . . in two different sizes . . . with two different products . . . by means of two different feeds . . . with two different types of sealing method . . . and two different types of pouch . . . at two different speeds.

Further, production is continuous. If one side is shut down for changeover or maintenance, the other side continues to operate. And the "1000" can be purchased as a single-tube unit and the second tube added later, all at less cost than separate units.

PLUS ALL THESE FEATURES—Speeds up to 150 packages per minute. Sizes from 2" x 3" up to 8" x 14½" (with 200 cu. in. of product). New plug-in sealing mechanisms for quick change of sealing method. Side-mounted filling tubes and web rolls for easy "threading" and accessibility to moving parts. Practically every type of heat-sealable film, paper, foil or laminate. Quickly adjustable volumetric pocket capacities. Much less floorspace than two single-tube units. Waterproof filling mechanism for steam cleaning and washing down. And all with complete flexibility of operation.



Write today for complete details and specifications on the versatile new STOKESWRAP "1000."

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JUNE 12-15, 1961

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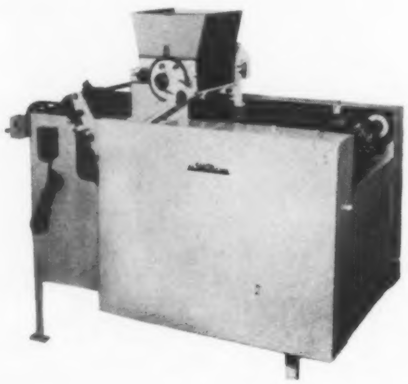
CHOCOLATE COATER.

Easy to install and clean. Pre-bottomer and cooling tunnels available. Made in belt widths 5" to 24".

CHOCOLATE MELTING AND TEMPERING KETTLE.
Prepares chocolate correctly for center covering. Easy to install, operate and clean. Electrically controlled. Available capacities 50 to 1000 pounds.

CREAM CENTER FORMER.
Rapidly and accurately produces centers. Does not compress lightest creams. Controlled size and weight of centers. Made in various sizes.



W. C. SMITH & SONS, INC.

2539 North 9th Street **Philadelphia 33, Pa.**

Big enough to serve you—Small enough to know you.

Cotton candy will soon be sold from three-wheeled motorized scooters. Eminating from New Hyde Park, N. Y., the franchised operation seems to be spreading across the country swiftly.

Cotton Candy Goes Door to Door

By B. W. Ricciuti

Cotton candy, dispensed midst a carnivalized atmosphere, is neighborhood bound via three-wheeled, motorized scooters.

Circus Cotton Candyman Inc. of New Hyde Park, New York, is preparing to unleash a fleet of ostentatious scooters, housing cotton candy mixing machines, and piloted by gaily attired vendors. They have 65 of the mobile units in production and hope to have 500 scooting about the country before the end of this year. Martin Lee Greenfield, president of Circus Cotton Candyman, asserts enthusiastically, "by 1965 we expect to have 5,000 vehicles on the roadways."

On the basis of successful trial runs in suburban New York areas, the Candyman organization believes each vehicle could gross $18,000 yearly; much more in regions where year 'round, warmer weather prevails. They have been stockpiling millions of paper cones, anticipating 70 million cotton candy sales in 1961. At the retail price of 15 cents each, gross receipts would register over 9 million dollars for their first full year of operation.

They view cotton candy's salability as yearlong, hampered only by rain or snow. And, to prove the lacy floss is as delectable in January, as it is in June, the Candyman people proudly point to field operation reports, one of which, summarized, reads as follows:

> On December 17, 1960, Circus Cotton Candyman, unit number 72, produced sales of $152.65 at the Mid-Island Shopping Center, Hicksville, New York, during the hours of 12:15 P.M. to 7:30 P.M., E.S.T., with average 27° temperature.

The parent company intends to keep a close relationship with their franchised dealers, supplying them periodically with promotional material, and offering special guidance in an effort to add impetus to cotton candy sales. For example, though Cotton Candyman units are built primarily for mobile vending, they feel the carts are extremely versatile and can be used profitably in other ways, such as stationary vending in shopping centers, amusement parks and on community athletic fields.

They will seek the tie in of their confection with grand openings, sale days and a variety of events for supermarkets and other retail businesses; also, in raising funds, on a share the profit plan, for fraternal, religious, civic and community groups. Another device they mention is the birthday party plan, whereby a Cotton Candyman, under a pre-arranged guarantee of sales, would arrive at a home to help a young host or hostess celebrate his or her birthday.

In an effort to standardize the product, they stipulate that the dealers must purchase the flavoring and the paper cones from the parent organization, so that Circus Cotton Candy, no matter where it is bought, has a distinct flavor in a familiar container. The paper cones, yellow and white striped, were specifically designed for Circus Cotton Candy. The dealers are allowed to buy the sugar ingredient wherever they choose, availing themselves of the best market price.

Replacement parts for the candy-mixer, uniforms and miscellaneous supplies are distributed by the parent company. A complete maintenance kit for the candy mixer is sold to the dealer; plus the uniforms

The younger set is fascinated by seeing cotton candy in production. Also the colorful circus-like scooter and gaily dressed salesman are eye stoppers.

(excluding white trousers that must be supplied by the dealer) consisting of a jacket, straw hat and a half-sleeved summer shirt. The utensils are a formula scoop, a metal canister that holds about 40 pounds of formula, and a coin changer.

Take home plastic bags, with bag ties, are moisture proof wrappers made of polyethylene. These and a bag spreader, to facilitate the insertion of the cones into the bag, are also part of the line.

How idea germinated

The idea to put cotton candy on the road is the work of Greenfield, an energetic 39 year-old former district sales manager for an eastern brewery. During a visit to the circus at New York's Madison Square Garden, in the spring of 1959, Greenfield was fascinated by cotton candy's drawing power. His two children enjoyed second helpings of the lacy floss which, he later estimated, were small portions of about 250,000 cones that were served up before the circus completed a one month stand at the Garden.

In the next few months, Greenfield became deeply engrossed with the thought of bringing the confection to youngsters, between the ages of 8 and 80, rather than limiting the sale of the popular candy to carnivals and other places of amusements.

Following almost a year of intensive research, Greenfield formed the Circus Cotton Candyman Company in May of 1960. But it was not until August of the same year that the first scooter was built.

It was an eye-catching contraption that drew guffaws from many passers-by, but it drew cotton candy consuming youngsters in droves. As an added attraction, the driver was dressed in a striped, red and white blazer and wore a bow tie and straw hat. The duo made an auspicious debut.

At the recent, third annual, Start Your Own Business Show, in the Bronx Coliseum, the Candyman display won wide approval, and the crowds were treated to free cotton candy. Since the show, Circus Cotton Candy has been besieged by inquires from prospective dealers throughout the United States and Canada; from servicemen overseas and even one inquiry from as far as Saudi Arabia. On the distaff side, a woman in Philadelphia is interested in a franchise, with the provision that she be allowed to re-design the driver's apparel to suit her taste. On the strength of the wide-spread response, the Candyman group feel that 1,000 scooters would be dotting the map in '61 if production permitted. But, only half the amount are expected to roll off the assembly line before the year is out.

The vehicle is said to be a gas miser, giving 75 miles to the gallon. The motor is virtually maintenance free and uses standard parts. No antifreeze is required. The cab is fully enclosed for the driver's comfort, and for summer vending the doors are removable and the cab's roof rolls back. The chassis is constructed of steel, and the vehicle has its own power and lighting system, which is adapted to A.C. current whenever it is available. Other features are: large stainless steel storage bins, safety locks and windbreaks. Festively colored and resembling a miniature carousel, it has a red and white striped, plexiglass bubble dome. The operator dispenses the candy from the rear of the wagon, where a plastic protector closes over the top of the candy mixer when it is not in use, sealing off dirt and grime.

The candy machine is efficient

The candy machine weighs 43½ pounds and operates on 110-120 volt, A.C., 60 cycles at 18,000 watts. Its mounting dimensions are 14½" wide by 18½" long by 19½" high. The machine is considered vibration free, has trouble free motion, and is designed to run for several years without losing one minute's production time.

Steel encased, the machine has a General Electric pump motor geared to run 10,000 hours without lubrication, and is equipped with extra heavy duty bearings, a Ward-Leonard rheostat, imbedded resistance coils, a fool-proof switch system with heat and motor on individual switches, clamped terminals and heavy wiring accessible from the front panel, and a precision tooled spinnerhead.

The mixing pan is made of spun aluminum. It fits over the spinnerhead, like a phonograph record on a turntable, with the spinnerhead protruding slightly

above the pan. The pan measures 25" in diameter and has 8" deep sides, straight up to contain the floss.

The spinning of cotton candy is a simple, yet fascinating operation. The formula consists of sugar and flavoring, premixed and contained in metal canisters until ready for use. A small amount of the formula is poured into the pan while the pan is rotating. The pan must be in motion as the mixture is poured to prevent the unbalancing of the pan which would, if stationary, rub against the rotating cylinder. Then, as the flavored sugar is melted and whirled at high speed it combines with air to form the cotton candy.

The operator dips a paper cone into the whirling floss, maneuvering cone to collect as much candy as the cone will hold. In the space of 8 seconds, an adept operator can pile the cone a foot high and almost as much wide. The color of cotton candy is controlled by the flavoring. At Circus Cotton Candy they boast of a variety of flavors including orange, vanilla-pink, cherry-red, blue-raspberry, strawberry, grape-purple, mint-green and lemon-yellow.

Cotton candy is a native American product, and its origin dates back to about 1900. Over the years, it has been as much a part of the circus as the clown. Now, far removed from its normal habitat, cotton candy is prepared to compete with the hot dog and the ice cream pop for the sidewalk trade, as Circus Cotton Candymen begin to ride the nation's highways and byways. That's not all. They are talking about "product rejuvenation—new and improved cotton candy—if and when the market calls for it."

Merchandising Memo

Candy for camp. Candy is often in the foreground when various civic organizations want to raise money for a variety of projects. During the month of April boys and girls of Davenport, Iowa, planning to go to YMCA & YWCA camps this summer, sold candy door-to-door to raise funds for the outings. We haven't heard definitely, but we have a hunch that several local candy firms were in on this project. If not, why not?

No shoes, no Candy. Just this spring when a bootery opened in a Wisconsin town, the owners announced that they would give a $1.00 box of candy (a name brand) with every pair of shoes purchased until April 1. Incidentally, the shoe store has also taken on the line of candy.

Music with Candy. A British candymaker has incorporated a 6-inch hi-fi record into the lid of its chocolate boxes and offers some 200 musical selections.

Candy Sells Appliances. A Colorado Springs Appliance firm, offering the "sweetest deal in town" used a 2-pound box of valentine candy to push appliances during Valentine week, last February. Purchasers of either an ironer, or a chord organ got "the sweetest deal", and also all children, who came into the store accompanied by parents, received free 5¢ candy bars.

Fish and Candy. Fishing season has, or will open in most sections of these United States very shortly. One manufacturing confectioner "fishes for business" by *going along* with the fishermen and fisherwomen in his community—a numerous breed indeed.

He places an accurate set of scales outside of his store. Any piscatorial persuiter may "come in" with a fish he has caught. It will be weighed and a "verification" card issued. This card attests to weight of fish, date brought in and by whom caught. With it, a fishing enthusiast may convince Doubting Thomas friends, neighbors or business associates as to his or her prowess as a fisherman.

A prize of a 5 lb box of candy is awarded weekly to the individual bringing in the biggest catch. Posters with name of weekly prize winner is posted in the candy store in a prominent position.

Window displays are arranged consisting of fishing equipment loaned for that purpose by cooperative sporting goods dealer friends. Together with boxes of candy and window cards pointing out that "Fishing takes time and candy devouring helps build energy to keep going."

This confectioner, moreover, uses newspaper ads listing places where fishing has been reported as being better than average. And suggests: "taking along candy for others of the party to munch on, especially the children, is a gracious and much appreciated gesture."

Recent Patents

2,973,273
SPONGE CHEWING GUM AND METHOD OF MAKING THE SAME
George Curt Curtiss, 187 NW. 67th St., Miami 50, Fla., assignor of twelve and one-half percent to Salvatore G. Militana, Miami, Fla.
Filed Feb. 11, 1959, Ser. No. 792,670
7 Claims. (Cl. 99-135)

1. A confectionery product comprising chewing gum having a plurality of cavities thereby forming a spongy mass and a confection embodied in said cavities.

2,975,062
COMPOSITIONS CONTAINING COCOA-BUTTER SUBSTITUTES
Cornelis Johannes Soeters, Rotterdam, Netherlands, Hermann Pardun, Kleve, Germany, and Antony Crossley, Wallasey, and Stanley Paul, Prenton, Birkenhead, England, assignors to Lever Brothers Company, New York, N.Y., a corporation of Maine
No Drawing. Filed Oct. 29, 1956, Ser. No. 618,682
Claims priority, application Great Britain Oct. 31, 1955. 7 Claims. (Cl. 99–118)

1. A chocolate composition comprising decorticated cocoa bean, sugar and additional fat, the fat phase of the composition consisting essentially of cocoa-butter and a tallow fraction obtained from a tallow of the group consisting of mutton and beef tallow, said fraction having an iodine value within the range of 28 to 40, a softening point within the range of 30° to 45° C., and a dilatation at 20° C. of not less than 1200, the said tallow fraction being present at a level of from 5% to 30% by weight of the mixture of cocoa-butter and tallow fraction.

2,975,063
COCOA-BUTTER SUBSTITUTES, PROCESS OF PREPARING SAME, AND COMPOSITION CONTAINING SAID SUBSTITUTES
Stanley Paul, Prenton, Birkenhead, and Antony Crossley, Bromborough, England, assignors to Lever Brothers Company, New York, N.Y., a corporation of Maine
No Drawing. Filed Aug. 7, 1957, Ser. No. 676,710
Claims priority, application Great Britain Aug. 10, 1956, 21 Claims (Cl. 99–118)

1. A process for preparing a cocoa-butter substitute from palm oil which comprises partly hardening palm oil and fractionating the partly hardened palm oil to obtain a fraction having an iodine value not greater than 45, a dilatation at 20° C. of not less than 1000 and a dilatation at 35° C. of not greater than 600.

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HAYSTACKS

BY ALLEN SCHWARTZ

Schwartz Candies, New York City

Formula:
10 lbs. molasses
4 lbs corn syrup
8 lbs. sugar
2 qt. water
11 lbs. medium shredded cocoanut
1 tbsp. salt
2 cups water

Procedure:

Place 6 lbs. of molasses in kettle with 8 lbs. of granulated sugar, 4 lbs. corn syrup and 2 qt. water. Cook until a good string (244°), add remaining 4 lbs. molasses and bring to a boil. Remove from fire.

Add 5 lbs. of *well toasted* shredded cocoanut (medium), 1 tbsp. of salt, and stir throughly. (This particular piece tastes best when the cocoanut is well toasted). Place batch back on stove over low flame. Add remaining 6 lbs. of cocoanut, stirring constantly, and cook until golden brown. As batch is cooking add 2 cups of water, ¼ cup at a time, so that batch will remain soft and tender. When it forms a soft ball, remove from fire.

We use an ice-cream scoop to make the mounds, scooping them out onto an oiled surface. The average size is 2 inches high with a base of 1-½ inches. We set each "Haystack" in a white paper cup and wrap it in cellophane or waxed paper. At 20¢ each, these are very popular.

What is your Weekend Special?

Submit your Weekend Special for publication in THE MANUFACTURING CONFECTIONER. For each one published we will pay $5.00.

Here's all you do:

1. List all ingredients of the formula.
2. Give a complete description of the mixing and handling procedure.
3. Give the name of the candy.
4. Give your name and address.
5. Send either a glossy photo of the candy, or a 1 lb. box of the freshly-made product so that we can photograph it. Put your name and address on the box too.

All published entries will be paid immediately upon publication.

Send entries to: Weekend Special, THE MANUFACTURING CONFECTIONER, 418 No. Austin Boulevard, Oak Park, Ill.

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NEWSMAKERS

The Dyna-Foam division, Sun Chemical Corporation has acquired 30,000 ft of additional space in Paterson, N. J. for increased production of Xanfoam, a candy packaging product. **Ernest H. Heath, Jr.** has been named sales manager, and the new Product Development Manager of the Dyna-Foam Division is **Douglas I. Hanson.** **Murray Sachs** is manager of the Paterson Branch.

Philip M. Barnhart is new midwest manager and **Alan P. Thomson** succeeds him as sales representative in Boston Area for Nashua Corporation's Flexible Packaging division. Barnhart will headquarter in the Chicago office of the New Hampshire firm.

New manager of research and development division of the A. E. Staley Mfg. Co., Decatur, Ill., is **Dr. James A. Bralley.** He succeeds **Dr. Thomas L. Gresham,** and formerly headed the chemical research department. Prior to joining Staley in July 1956, Bralley was senior chemist in process development laboratories of Rohm and Haas Co., Bristol, Pa. Dr. Gresham will receive an honorary degree of doctor of science from Emory University in June for his 29-year contributions to science. Also, **Dr. E. Eugene Fisher** has been named director of chemical research at Staley.

Edward E. Langenau, vice president and director of analytical laboratories, Fritzsche Brothers, Inc., New York City, recently became a member of the firm's 25-Year Club along with **Henry Bechtolf,** flavor chemist.

Max D. Zauke is new assistant Chicago manager of The Hubinger Co., Keokuk, Iowa producer of corn starches, corn syrups and corn syrup solids.

Roy C. Baker has been named project director, Psychometrics division United States Testing Company, Inc., 1415 Park Ave., Hoboken, N. J. The division, staffed by professional psychologists, designs and conducts research on consumer reactions and attitudes toward products, packages, and advertisements.

Rapid-American Corp., New York 22, N. Y., has purchased Cellu-Craft Products Corp., New Hyde Park, N. Y. converter, designer and printer of flexible packaging materials.

Dr. John M. Jackson, research division of American Can Co., Barrington, Ill., is president-elect of Institute of Food Technologists. He will be installed at 21st Annual meeting of the Institute, Hotel Statler Hilton, New York City, on May 10, and will take office in June 1962 at the annual meeting in Miami Beach, Fla.

George Simpson Perkins, chief engineer of National Equipment Corp., New York City producer of confectionery and chocolate machinery died.

He was associated with National for over 50 years and combined his experience with firm's new creative engineering talent to help develop the company's high production equipment.

Fred H. Groen is new chairman of the board of Groen Mfg. Co., Elk Grove Village, Ill. producer of steam jacketed kettles. **Fred H. Groen, Jr.** is newly-elected president, and General Sales Manager **F. J. Corcoran** has been made a vice president, along with **Robert F. Groen.** The latter is in charge of the Eastern sales office in Teaneck, N. J.

Robert D. Coe is new salesman in the Northwest territory for Modern Packages division, Standard Packaging Corp. The New York City firm produces cellophane polyethylene and laminated packaging material of film, paper, and foil in roll stock for automatic packaging machines.

Dr. John E. Snow is new research director and **Harlan V. Anderson** is manager of product development for The Rap-In-Wax Company.

Sales office of Dodge & Olcott, Inc. has been moved from Boston, Mass. to 600 Main St., Waltham 54, Mass.

Dr. Ernest M. Weber is new vice president, research and development at Chas. Pfizer & Co., Inc., 235 E. 42nd St., New York City. Also, **R. J. Taylor,** former manager of chemical development, is new director of chemical products and development.

Charles A. O'Donell is new general manager of Flow Equipment Corp., Little Falls, New Jersey firm handling liquid automation equipment for users of liquid and dry sugars, corn syrup and blends, shortening, and liquid chocolate.

Dr. Luther S. Roehm is new vice president, marketing, of Merck Chemical division, serving among others, the food industry.

New candy broker is All Best Confections, Inc., 333 Griggs Midway Building, 1281 University Ave., St. Paul, Minn. Principals in the firm are **Robert W. Inserra** and **Joseph Kreimer,** both former representatives of the Ever Heilig Brokerage Co., Minneapolis. Inserra has had 10 years experience in confection merchandising and sales, and Kreimer has represented confection brokers for 13 years.

W. S. Hopson has joined Dorset, Dunbar & Mundy, Richmond, Va. candy brokers.

Frank B. Reynolds, former sales manager, J. W. Greer Co., Wilmington Mass., producer of continuous candy production equipment, has been named vice president in charge of operations.

Carter L. Burgess, president, American Machine and Foundry Co., New York City, has been named a director-at-large for a two-year term by the Chamber of Commerce of the United States.

W. Andy King is new sales rep in the South Carolina area for Clinton Corn Processing Company, Clinton, Iowa.

Pylam Products Co., Inc., manufacturers of custom-blended colors and dyes, has moved into its new building at 95-10 218 St., Queens Village, Long Island, N. Y.

Newly-created candy division has been set up by The Thad F. Adams Sales Co., 2036 Champa St., Denver 5,

Colo. **H. Alex Rosenfelder** will head the division. Company President **Thad F. Adams** is also Secretary of the Associated Brokers of America.

Cleveland and Chicago district managers have been appointed by The Dobeckmun Co., division of The Dow Chemical Co. **Arthur J. Myers** goes to Cleveland and **George F. Klein** to Chicago. Myers replaces **George A. Fendrick**, and Klein succeeds **Robert J. Smith**, new northwest regional sales manager.

Wagner Van Vlack is vice president and marketing division general manager of Milprint, Inc., Milwaukee printer and converter of flexible packaging materials. This is a newly-created post at Milprint, subsidiary of Philip Morris, Inc.

2 CM 2000 Moguls replace 4 starch moulding units at Moirs Limited

You require savings like this...at a time when all costs are rising!

Moirs
LIMITED
128 ARGYLE ST.
HALIFAX, CANADA

December 28, 1960

Mr. Herman Greenberg, President,
National Equipment Corporation,
153-157 Crosby Street,
New York 12, N. Y.

Dear Mr. Greenberg:

Our answer to recent enquiries about our experience with our new CM 2000 Mogul and its year old companion has been that these two Moguls are producing substantially more centers than the four which they replaced, the four consisting of two AD Woods and two from abroad, all four being postwar machines.

The performance of the CM 2000 Moguls has fully confirmed your promise of accurate uniform weights, practically no tailings, excellent cleaning of centers and reliable operation.

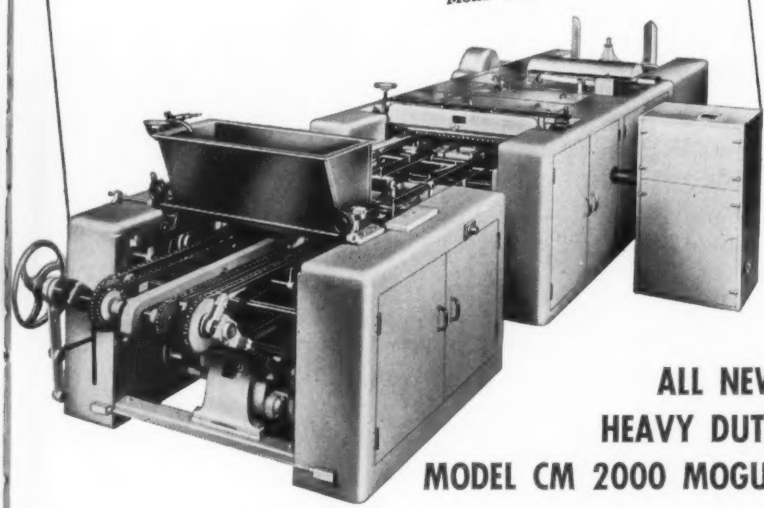
In a few words, the results have proved that we made the right decision in re-ordering National Equipment Corporation Moguls and we are enthusiastic about their operation.

With kind regards,

Yours very truly,

J. D. Fraser

J. D. Fraser,
Assistant General Manager,
Moirs Limited.



ALL NEW HEAVY DUTY MODEL CM 2000 MOGUL

HERE'S PROOF OF PERFORMANCE!

J. D. Fraser,
Assistant General Manager,
Moirs Limited

says . . .

"The performance of the CM 2000 Moguls has fully confirmed your promise of accurate uniform weights, practically no tailings, excellent cleaning of centers and reliable operation."

ONLY THE FITTEST HAS SURVIVED!

National Equipment has been the only builder of starch moulding machines who has been able to stand the test of time and has earned world-wide customer satisfaction and recognition. We have established our leadership by going ahead with imaginative engineering and painstaking craftsmanship to design and build the best possible Mogul for the candy manufacturer.

These exclusive features add up to the CM 2000 Mogul's superiority

* Increases in production of up to 50%.
* Perfectly clean centers.
* Pinpoint detail in moulding.
* No breakdown of starch moulds at high operating speeds.
* Micro-accurate weights of centers.
* Precision control—no scrap, no waste.
* Rugged construction to prolong machine life and cut maintenance costs.

If you need a new or additional Mogul, you're already paying for it in lost profits. Therefore you cannot afford not to invest in the latest and most efficient Mogul.

National Equipment will assist you to get the Model CM 2000 Mogul NOW, when you need it most! You can pay for this new Mogul over a period of time during which the savings you earn will cover your payments.

DON'T DELAY!

Our engineers will be happy to visit your plant and assist you in planning how to integrate a CM 2000 Mogul with your manufacturing operations for greater profits. No obligation.

NATIONAL
EQUIPMENT CORPORATION

153-157 Crosby Street
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163-167 North May St.
Chicago 7, Illinois
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For Sale Piecemeal

MOST MODERN

CANDY MACHINERY

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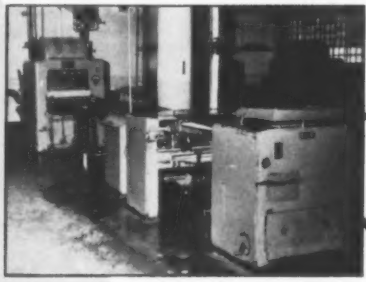
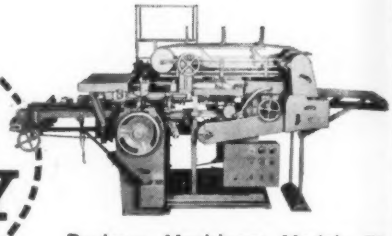


Greer 24" and 32" Streamlined Chocolate Coaters with Feeders, Bottomers and Cooling Tables, Strokers and Cooling Tunnels. (Can be purchased as complete lines or as individual units.)

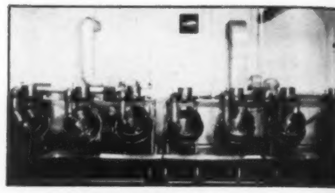


Package Machinery Models FA, FA-2, FA-3 and FA-4 Automatic Adjustable Wrappers. With and without Electric Eyes.

DAGGETT CHOCOLATE COMPANY

400 Main Street • Cambridge, Mass.

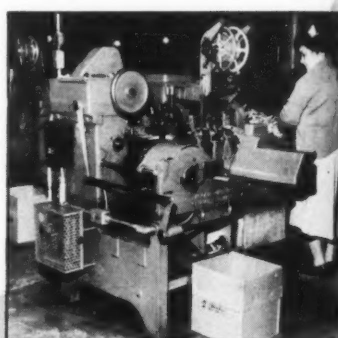
National Equipment Chocolate Melters. 300 lb., 500 lb., 1,000 lb., 2,000 lb. capacities.



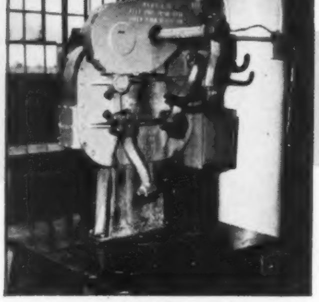
7—Stainless Steel Revolving Pans with cold or hot air Blower, Sugar Duster. Each pan is separately removable from base by handles. (All or part can be purchased.)

- **Must be moved immediately.**
- **Equipment priced very low for quick removal.**
- **Inspection can be arranged.**

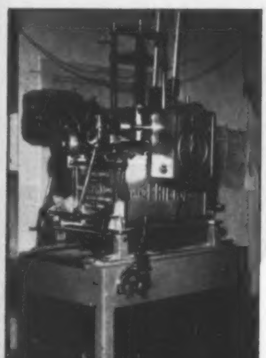
Simplex Steam tilting-type Cream Cooler with two 5 ft. Cream Beaters.



Package Machinery LP-3 Sucker Wrappers.



Hildreth Form 6 Double Arm Puller.



Friend New Englander large production Automatic Hand Roll Plastic Center Machine with motor and controls.

10—Collum Coolers. 3 ft. x 8 ft.

These Offerings Are Subject To Prior Sale

Act Now!

WRITE, WIRE, PHONE COLLECT

for complete details and for our low bargain prices and also, to arrange to inspect this equipment

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UNION Rebuilt Machinery Established 1912

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THE MANUFACTURING CONFECTIONER'S CLEARING HOUSE

Address replies to box number, c/o The Manufacturing Confectioner, 418 N. Austin Blvd., Oak Park, Illinois

MACHINERY FOR SALE

One 100 lb. gas Simplex vacuum cooker with two kettles, new pump –$600. One Racine sucker machine with three sets of rollers–$150. Box 5611, **The MANUFACTURING CONFECTIONER.**

Vacuum cooker, cream beaters, chocolate melters, stoves, cutrolls, pullers, batchrollers, kettles, cooling slabs, Hobart beaters, cutting machines etc., S.Z. Candy Machinery Co., 1140 North American St., Philadelphia, Pa.

Two late style instant fondant machines, complete and in good order. Box 5613, **The MANUFACTURING CONFECTIONER.**

2 Latini 38" revolving pans (grossing), 5' Racine fondant table beater, Model K kiss machines. Box 5614, **The MANUFACTURING CONFECTIONER.**

N. E. continuous cooker, late style; Peerless plastic machine with 3 dies; Forgrove foil wrapper for mint patty. Box 5615, **The MANUFACTURING CONFECTIONER.**

Berks mixer, LP pop wrapper for ball shaped pops, Racine 32" depositor, 48" Greer enrober, Instant Fondant machine. Box 5616, **The MANUFACTURING CONFECTIONER.**

Simplex gas vacuum cooker. Corley Miller overwrapper, copper revolving pan, Savage Model S fire mixer, Racine continuous cutter, four arm pulling machine, York batch roller, Mills continuous cutter, steel slab, Mills electric batch warmer, Mills drop machine, jumbo sucker press, Hohberger cut rock cutter, gas nut roaster, forced draft furnace, copper open fire kettles. Miscellaneous hand tools. Bud Candy Co., 208 West St. Clair Ave., Cleveland 13, Ohio.

One practically new cutting machine for stick candy. Operates to 200 strokes per minute. Air operated. $650.00 Perfecto Machine Co., 319-18th Avenue, North, Nashville, Tenn.

MACHINERY FOR SALE

Duplex, heavy duty, high speed Racine sucker machine with dies. 7 ft. York reversible batch roller. 50 ft. cooling conveyor with blower and shaker. Two Harry Davis Count-O-Matic sucker wrapping machines with table. All priced for fast sale. Sisco Brothers Candy Co., 1237 N. California Ave., Chicago 22, Ill.

One CM-3 brand new Package Machinery cellophane overwrapping machine with tear tape attachment. Good price for fast sale. Box 4611, **The MANUFACTURING CONFECTIONER.**

40' x 4' chocolate cooling tunnel with variable speed drive and refrigeration unit. Photographs and additional information available on request. Katherine Beecher Candies, Manchester, Pa.

FOR SALE

Bonus Cluster Machine.
Model K #3 Savage Fire Mixers.
20 gal. & 50 gal. Model F-6 Savage Tilting Mixers, copper kettle.
200 lb. Savage Oval Top Marshmallow Beaters.
Cut-Rol Cream Center Machines.
Bostonian Friend Hand Roll Machine.
1000 lb. Werner Syrup Cooler.
150 lb. to 500 lb. Chocolate Melters.
24" and 32" N.E. Enrobers.
32" Kihlgren Stringer.
Simplex Gas Vacuum Cooker.
Simplex Steam Vacuum Cooker.
Savage Cream Vacuum Cooler
600 lb. Continuous Vacuum Cooker
Form 3 Hildreth Pullers.
Form 6 Hildreth Puller.
National Cherry Dropper.
6' and 7' York Batch Rollers.
National Wood Starch Buck.
National Steel Starch Buck.
Bausman Twin Disc Refiner Unit.
Ball and Dayton Cream Beaters.
30 Gal. Stainless draw off steam jacketed kettles.
100 lb. cap. Resco chocolate melting and tempering kettle.
Savage Caramel Cutters.

SAVAGE BROS. CO.
2636 Gladys Ave. Chicago 12, Ill.

SITUATIONS WANTED

Technician in chewing gum base and general candy pan line, also starch jelly, taffy, caramel, nougats, fondant, fontex, crunches will teach all over the world. Knowledge of all phases of candy. Best references. Box 3613, **The MANUFACTURING CONFECTIONER.**

Leading confectionery authority, British, qualified scientist. 20 years experience in the industry in Great Britain and Europe in general management, quantity and quality production control, manufacturing techniques, formulation, research, development, export control, etc. Offers personal consultancy services in the United States, Canada and Europe. Most British varieties covered. British agency facilities also available. Box 5618, **The MANUFACTURING CONFECTIONER.**

HELP WANTED

Hard candy maker. Working foreman. Excellent opportunity with outstanding Chicago kitchen for an experienced hard candy maker. Must be capable of making a full line of high quality hard candy. Will have full responsibility for our hard candy operations. Semi-mechanized department. Knowledge of modern manufacturing equipment and production methods plus the ability to perform various hand operations required. Excellent starting rate plus a good range of fringe benefits. Please state full qualifications and earnings in your first letter. Box 5619, **The MANUFACTURING CONFECTIONER.**

Salesmen wanted. Cellophane–Polyethylene. Bags–Rolls–Sheets. Openings for exp. or well connected salesmen. Unusual opportunity for intelligent and imaginative men with old est. fully equipped firm. Sal. plus bonus or com. only for part time men. Reply in confidence. Mason Transparent Package Co., Div. Mason Envelope Co., Inc., 1180 Commerce Avenue, N. Y. 62.

HELP WANTED

Year round position available in Palm Beach, Florida for A-1 candymaker. Must be able to make crunches, sugar mints, fudges, glaces, etc. Some store managerial experience also desirable. Box 5617, **The MANUFACTURING CONFECTIONER.**

BUSINESS OPPORTUNITIES

Candy manufacturing wholesale plant in Oklahoma, well equipped with Hudson Sharp wrapper. Now serving 12 states in the Midwest. Also retail outlet on U.S. 66 and Interstate 40 highways. Box 5612, **The MANUFACTURING CONFECTIONER.**

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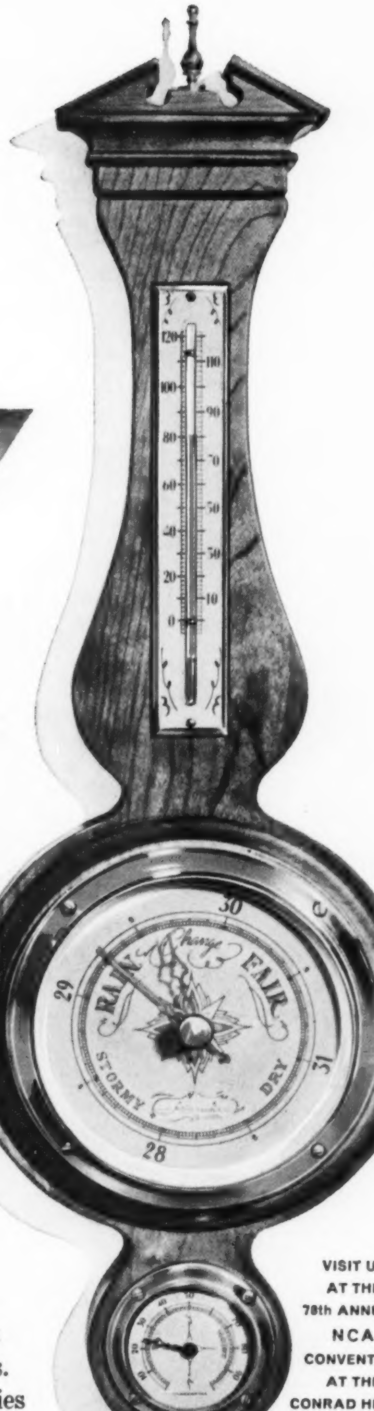

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